

Research

Horizons

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Issue 32

Special issue on
Africa

Featuring
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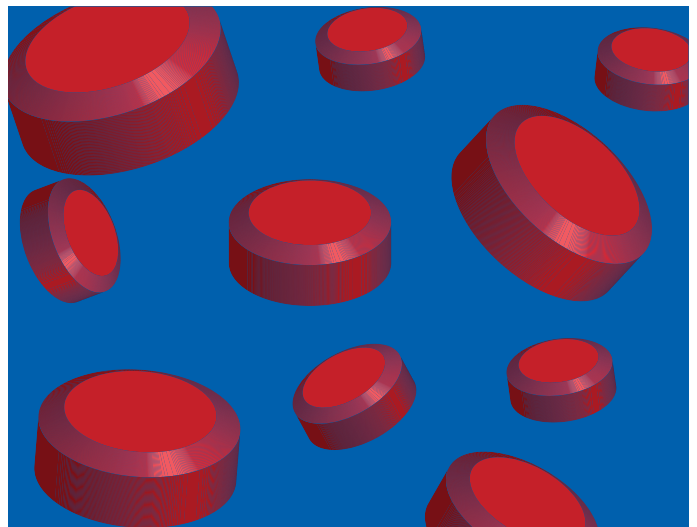
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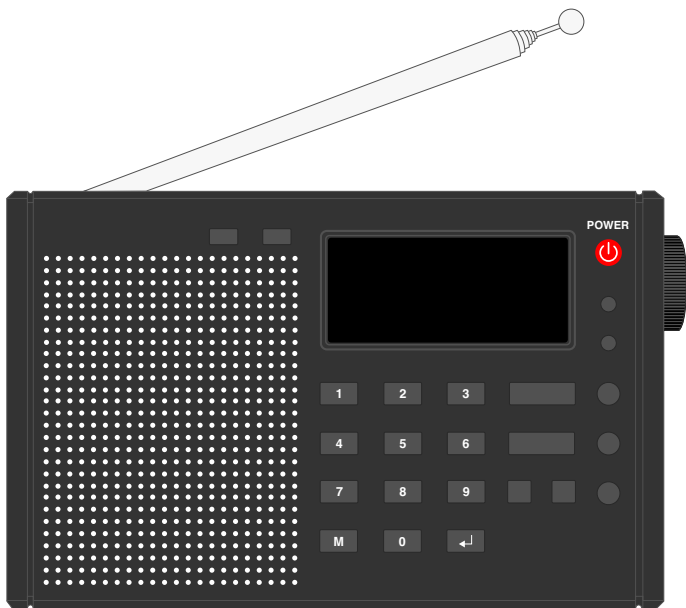


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Editor

Dr Louise Walsh

Design

The District

Editorial advisors

Dr Pauline Essah, Professor Harri Englund, Dr Toby Wilkinson

Writers

Craig Brierley, Alex Buxton, Sarah Collins, Jacqueline Garget, Fred Lewsey, Stuart Roberts, Louise Walsh

T +44 (0)1223 765 443

E research.horizons@admin.cam.ac.uk

W cam.ac.uk/research

Welcome

Collaboration with Africa is embedded in the University of Cambridge's DNA. I am paraphrasing our Vice-Chancellor, Professor Sir Leszek Borysiewicz, but there is no better way to describe the scale and vitality of Cambridge's partnership with the continent. This special issue on Africa celebrates some of these partnerships that have made Cambridge one of the world's leading universities for engaging with and supporting African research.

Many of our researchers have long worked with African colleagues on issues that matter not just to the continent but to the world. Our Centre of African Studies, a hub for Africa-based scholarship, celebrated its 50th anniversary in 2015. And our Cambridge-Africa Programme provides a framework that makes the mentorship and personal commitment of our researchers available to African researchers working in Africa on African priorities.

Africa is a region of rapid economic, demographic and population growth, with unresolved challenges in areas such as health, education, governance, poverty and nutrition. It has excellent researchers, but too few to train and mentor the millions it needs to accelerate its progress. It has good universities but many are too under-resourced to be internationally competitive. This is where global, research-driven universities across the world can help.

Engagement through research partnership and capacity building is embodied in the Cambridge-Africa Programme, which today involves over 200 researchers working in over 30 fields of research across the University and affiliated institutions. They engage with research partners in 26 African countries. These interactions, in turn, enrich the intellectual and cultural environment of our academics and students, helping us to be a truly global university.

Being a global university means understanding that what we do at home can positively affect lives, and livelihoods, on the far side of the world. It requires us all to take full responsibility for that knowledge – and to act on it, together.

It means knowing, for instance, that collaboration between viral experts in Cambridge and plant scientists in Africa can help make crops in Ghana more resilient. It means understanding that the knowledge developed by clinicians in a Ugandan maternity ward supported by Cambridge researchers can save lives everywhere. And it means recognising that evidence collected through collaborations with NGOs, peacebuilders and research institutes working on the ground can make a difference in areas as diverse as education, post-conflict resolution and nutrition.

Last year, I was invited to attend a meeting of the International Alliance of Research Universities at the University of Cape Town in South Africa. The theme of the meeting was 'Global transformation'. My participation prompted me to wonder: what if every one of the world's leading research universities could do something similar to the Cambridge-Africa Programme? Imagine the effect that the commitment, and the concerted efforts, of the world's top research-intensive institutions might have on Africa's capacity to produce knowledge. That would be global transformation indeed.

Professor Eilís Ferran

Pro-Vice-Chancellor for Institutional and International Relations

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“A GIRL WITHOUT EDUCATION IS NOTHING IN THE WORLD.”

Half the children in Africa miss out on school and basic learning as a result of poverty, gender or disability. While major efforts are being made to reverse this situation, Cambridge researchers are working with NGOs on the ground to ask what works, why and how much it costs.

By the time she was 13 years old, Vumilia had supported herself through primary school by collecting and selling firewood. Now she faced an even greater challenge. After weeks of anxiety, Vumilia left home at 4.30 a.m. to walk the 10 km to secondary school; she had no pencils, no uniform and no money to pay her school fees.

Twelve-year-old Husna had no choice but to leave school to work, helping to support her grandmother and siblings on her US\$14 a month working as a housemaid. Husna would wonder what lay ahead of her: “I was imagining that my life would be horrible. Because even if I stopped being a maid, where would I go? What would I do?”

Catherine also saw a bleak future. After the death of her father, her uncles took her family’s land. Some days Catherine would manage to go to school; on others she would sell food by the roadside. “I would see other children studying and all the time I would just look at their exercise books and try to learn. I was imagining my future as going into a big hole where no one could help me. A girl without education is nothing in the world. Education is everything.”

Vumilia, Husna and Catherine all live in Tanzania in East Africa. With an economy based largely on agriculture,

Tanzania has among the lowest rate of secondary school enrolment in Africa. Many girls from poor, rural families can’t afford the cost of going to secondary school and leave home to become ‘house girls’ in urban centres. There, they sometimes experience abuse and exploitation, returning home infected with HIV, or pregnant. Sadly, Catherine’s prediction of a desperate future is all too accurate.

“Education is a fundamental human right,” says Professor Pauline Rose from Cambridge’s Faculty of Education, “but moving between that undeniable statement and on-the-ground change is a long and complex process. Education is at the heart of social transformation – it increases opportunities in life, can pull people out of poverty, empower women and drive economic growth. Understanding the barriers that prevent this happening is crucial.”

Rose is Director of the Research for Equitable Access and Learning (REAL) Centre in the Faculty of Education. Working with NGOs, schools and education policymakers in African countries, India and Pakistan, her team is highlighting the factors that limit children’s learning and the mechanisms that can improve the effectiveness of teaching.

“Firstly, children need to be able to access primary and secondary school. But it is also important to make sure that this is valuable – there’s little point



Words
Louise Walsh



Image
Vumilia walks 10 km to school

EDUCATION IS EVERYTHING”



Credit: Camfed/P. Hayes

in being in school if children don't learn the skills they need," she explains.

"And while this needs to happen for all children, we know that it is often girls from poor households who are the most disadvantaged when it comes to completing education."

Fortunately for Vumilia, Husna and Catherine, they are now among over 40,000 Tanzanian girls who in the past decade have been helped into secondary education by the non-profit organisation Camfed (Campaign for Female Education), with whom the REAL team has a research partnership.

Since 1993, Camfed has supported more than 1.6 million students in five African countries to attend primary and

secondary school, and has benefited nearly four million children through the provision of improved learning. A range of barriers to schooling are targeted through scholarships, mentoring, educational resources and community-led initiatives.

The organisation particularly focuses on those girls who are poorest and most likely to be excluded from the school system, and at an age where they are at greater risk of dropping out due to poverty, early marriage or pregnancy.

"There is a pressure in the development sector to want to find the 'silver bullet' – find the vaccine – in terms of what can be done to effect social change," explains Camfed CEO Lucy Lake. "We see girls' education

as the starting point to everything – from tackling poverty and early mortality through to driving economic development – it generates a multiplier effect like no other."

However, Lake is quick to point out that there is still much to be done to raise learning outcomes for all, and that evidence is crucial. "Reducing the chance that children leave school early or without basic literacy and numeracy skills is clearly important but which interventions work best, with whom and when?"

Rose's team is helping Camfed unpick the basis of the organisation's on-the-ground results. Building on the evidence of Camfed's successful programme, the research will not only provide a

A close-up portrait of a young girl with short, dark hair, smiling warmly at the camera. She is wearing a white school shirt with a red neckerchief. The background is a blurred outdoor setting with green foliage and a building.

**“EDUCATION IS
A FUNDAMENTAL
HUMAN RIGHT”**

unique large-scale analysis of the cost-effectiveness of educational programmes, but will also contribute to understanding how they can be sustained.

“An obvious point, but an important one to make, is that it’s not that poor children can’t learn,” says Rose. “It’s that the conditions that affect whether they go to school and stay in education are much worse. Our evidence shows for instance that when poor children and rich children are in the same class there’s a very, very narrow learning gap. But what is less clear is by what mechanism targeted support can level the playing field.”

Rose continues: “It’s all very well saying how beneficial Camfed’s programme is but we also need to assess why, and how this can be replicated across an education system.”

Three years ago, Camfed won funding from the UK’s Department for International Development (DFID) to scale up their work as part of the Girls’ Education Challenge programme. Lake describes how they saw this as an opportunity to do this at the community level rather than at an organisational level. “More girls would gain if we could scale locally without needing to grow a costly and potentially unsustainable organisation at this end,” she explains.

“Because disadvantage is so nuanced, we work with local communities to identify who should receive scholarships. As a result, there’s a sense that these are the community’s resources and not the resources of an organisation coming in and making decisions.”

Securing funding from DFID was also an opportunity to take a critical look at precisely how Camfed’s programmes are meeting the needs of those who are most marginalised. Camfed routinely collects data for evaluation purposes and they now turned this over to Rose’s team at the REAL Centre for deeper analysis.

Rose explains: “We are independent – we aren’t wishing to make a case one way or the other. We could see how these data could help us uncover the factors that limit children’s learning, which could have lessons beyond Camfed’s own programme. Globally, even after going to school, 250 million children cannot read, write or count. It’s been described by UNESCO as a global learning crisis.”

With funding from Echnida Giving, the REAL team has recently completed its first analysis of Camfed’s data in Tanzania, comparing enrolment and learning outcomes for girls supported by the organisation with those for girls who didn’t receive support. “We found that marginalised girls receiving a bursary were about 30% more likely to stay in education, and those in Camfed-

supported schools on average tripled their assessment scores compared with those in other schools,” Rose says.

They also looked at how the Camfed programme’s influence on self-esteem affected learning. In particular, a system of ‘Learner Guides’ aims to expand the presence of female role models, lead students through a broad life skills curriculum, organise academic study groups, and provide counselling and follow-up on students in danger of dropping out. Again the programme was found to benefit the learning of those identified as having low self-esteem before the intervention.

“We have quantitative evidence that what Camfed is doing works,” Rose adds. “The next questions are: how much does it cost to reach the most marginalised girls, how far can it be scaled up and how sustainable is it?”

“It’s a powerful piece of knowledge for any government”

National governments need these answers to consider policy changes and budget allocation. In fact, Camfed’s approach has always been to work in tandem with local stakeholders.

“Whenever we start in a country, we never start with setting up an office, we always start with the Ministry of Education,” says Lake. “We work with them to identify those areas where there is the greatest disparity in terms of enrolment, academic performance and so on, and where it makes sense for us to come in as a partner to work on improving those areas.”

However, as with any NGO, there is always a danger that if funds were to run out then the programmes could falter and fail. Understanding cost-effectiveness, says Rose, is imperative to understanding how any NGO programme can be sustained: “There have been assessments for how to improve access to school and how to improve learning but very little on both together.”

Lake highlights the timeliness of the study: “While there’s a general movement towards ensuring that there’s free education for all, there’s a real concern that expansion in secondary level provision might lead to exclusion of those who are most marginalised.”

It’s also vital not to lose sight of primary education in the mix, says Rose: “There’s only so much you can fix once children get to secondary school. If you don’t start early enough then you will only have a select group of children who will benefit from improved education later.”

Her team works with the People’s Action for Learning (PAL) Network – an independent organisation that measures basic reading and numeracy abilities of children across three continents through annual citizen-led assessments. Since these skills are mostly learned at primary school, the partnership between the REAL Centre and the PAL Network is helping to work out how well the building blocks for future progress in school are being laid down at this early age.

“We are now in a position to look at the bigger picture, thanks to recent funding by the Hewlett Foundation,” Rose explains. “It’s vitally important to collect data on children’s learning. We now want to ask how this collecting of data has motivated or contributed to community engagement at making schooling more effective at a country-wide level.

“Just knowing that there are low levels of learning is not going to change anything – the idea is to strengthen the accountability of schools and policymakers at the local level by making information from surveys available to communities, and ensuring they have the support to use these data effectively.”

When Lake is asked whether she thinks the United Nation’s Sustainable Development Goal of ensuring that “all girls and boys complete free, equitable and quality primary and secondary education” will be met by 2030, she says: “It’s a tall order. There is momentum building but the next 18 months will be critical in terms of seeing what level of investment or commitment there is in practical terms.

“But that doesn’t mean to say it’s not possible, and understanding the costs will be important to achieving the goal. It’s a powerful piece of knowledge for any government to know what to look at in policies around education.” Rose agrees: “Our new work is helping to move beyond rhetoric – to provide answers for where we want to be in 2030.”

I **Lucy Lake**
Camfed, Cambridge
llake@camfed.org

Professor Pauline Rose
Research for Equitable Access
and Learning Centre, Faculty
of Education
pmr43@cam.ac.uk

BY THE LADY IRON



Words
Louise Walsh

Iron deficiency can be fatal. But in countries where patients are also likely to have other serious diseases, so too can the iron supplements used to treat it. Nearly 12 years ago, Dora Pereira – sometimes referred to as ‘The Iron Lady’ – was part of the team who had an idea for a new supplement. She now leads its clinical trial in The Gambia.

There’s a strange paradox when it comes to iron deficiency anaemia. We’ve been able to treat the condition for almost two centuries, ever since French physician Blaud of Beaucaire introduced ‘A Readily Assimilated Form of Iron for Making the Blood Red and Healthy’. And yet, in developing countries, where some of those people who are most susceptible to anaemia live, taking an iron supplement can make things worse.

Oral iron supplements contain iron in a form that dissolves quickly in the gut, passes rapidly into the bloodstream, and makes itself available for its many vital functions: carrying oxygen, building DNA and powering muscles. No wonder it’s the treatment of choice.

But, says Cambridge researcher Dr Dora Pereira, the situation is far from straightforward if the patient is not only anaemic but also carrying any one of a number of infections that are endemic in developing countries: hookworm, malaria, HIV, salmonella and amoebic dysentery, among others.

“By making iron available to the cells of the patient, you are also making it available to the cells of any pathogen they carry. The results can be far worse than the anaemia they are being treated for,” she explains.

“This is why the global burden of iron deficiency anaemia hasn’t changed in the past 20 years, particularly in children and women of reproductive age. In developing countries, taking oral iron supplements may be associated with increased infection if there is no appropriate infection control available. Unfairly, the most-deprived populations with the highest burden of disease also do worse with currently available iron supplements. So, despite considerable public health efforts, the most widespread nutritional deficiency remains without an effective cure.”

Nearly 12 years ago, while at the Medical Research Council (MRC) Human Nutrition Unit in Cambridge, Pereira and colleagues began to question whether the right type of iron was being used to treat anaemia.

“If you look at our diet, we obtain iron from red meat, pulses, whole grains and leafy greens, and in all of these the iron is found in a less ‘accessible’ form than the soluble iron currently used in supplements,” says Pereira.

“The body needs to work harder to release it, which happens within the cells that line the gut. This slows down how available it is to the body, and to pathogens. In fact, this ‘slow release’ of iron may be an innate mechanism that humans have developed throughout evolution in order to live with the many flora and fauna that colonise our guts.” They began looking for an alternative.

Iron exists in hundreds of different forms. The one we see on rusty pipes is a very crystalline and stable iron oxide; if we were to eat this we’d take in very little. At the other end of the spectrum are the soluble forms. “But the forms you find in food and those which form during digestion are not soluble forms of iron. So we decided to make a synthetic form that mimicked this more stable mineral and particulate iron structure. In a nutshell, this is a more available form of ‘rust’.”

The result is IHAT (iron hydroxide adipate tartrate; the A and the T stabilise the iron and are widely used as food additives). IHAT behaves like the iron forms that are found in our diet – it doesn’t dissolve in the gut. It’s taken up whole as nanoparticles by cells in the lining of the gut and it’s broken down inside these cells – mimicking what happens with iron in the diet, and resulting in a slower release of iron into blood.

There is also another advantage. Unlike IHAT, the soluble form of iron in current supplements is what’s called ‘redox reactive’ – it can react with oxygen to produce free radicals that damage the gut lining and contribute to the side effects of taking iron supplements such as diarrhoea, constipation, abdominal pain, cramps and heartburn.

“The global burden of iron deficiency anaemia hasn’t changed in the past 20 years”

“In developed countries these may be uncomfortable, but in developing countries side effects like diarrhoea can be life-threatening, particularly in children when associated with pathogens such as *Salmonella*,” adds Pereira.

IHAT has already been tested in ‘first-in-man’ studies and a Phase II trial is now being conducted in 700 children in The Gambia, funded by the Bill & Melinda Gates Foundation Grand Challenges in Global Health programme. The trial is in collaboration with the MRC Unit in The Gambia, West Africa, and is co-led by Professor Andrew Prentice (MRC International Group and MRC Unit, The Gambia), an expert at conducting oral iron intervention studies in rural Gambia.

Pereira hopes that the IHAT supplement might provide the solution to what the World Health Organization (WHO) has called ‘a public health condition of epidemic proportions’. Lack of iron, and its associated anaemia, is the largest nutritional deficiency disorder in the world today, affecting two billion people. In developing countries, where bland diets contain too little iron and infectious

diseases reduce iron absorption, at least half of all pregnant women and pre-school children are estimated to be anaemic.

Iron deficiency anaemia causes the death of around 0.8 million people each year, and many millions more are affected by an associated lowering of IQs, complications in pregnancy and unproductive working lives, all of which limit national development.

This is why in countries where more than one in five young children have anaemia, iron compounds are included in a powdered mix of vitamins and minerals made freely and widely available by UNICEF, the World Bank and NGOs.

Keeping an eye on the costs of IHAT has been crucial – if the clinical trials are successful, then the researchers need to be sure that the end product will be affordable and can be made in large quantities. Their current financial projections suggest that a month-long supply of a daily dose will cost around \$1–2.

Pereira’s team has been helped with thinking ahead to the marketplace through a mentorship programme with GSK (GlaxoSmithKline), which began after IHAT won the 2014 Emerging Technologies Prize from the UK Royal Society of Chemistry.

“This has been a tremendous help,” says Pereira. “Throughout the years there were many instances where we couldn’t get funding. To many, this type of research seems more like a social enterprise than a business opportunity. But there is no reason why women and children should be dying of iron deficiency anaemia in the world today.”

“And if we are successful, then this would be a safer option with fewer side effects for anyone in the world who needs iron. If it works, it will be a very nice story of a very simple solution.”

 **Dr Dora Pereira**
Wellcome Trust-Cambridge Centre for Global Health Research,
Department of Pathology
diap2@cam.ac.uk

WHEN IDEAS OF PEACE MEET POLITICS OF CONFLICT

Research by an expert in peacebuilding shows how international ideas, practices and language of conflict resolution are transformed when they meet African “realities and politics on the ground”.

Burundi has experienced cycles of violence, civil war and even genocide since achieving independence from Belgium in 1962. So, when this small central African country finally held democratic multiparty elections in 2005 following a lengthy peace process, the international community cheered.

Here, perhaps, was a nation set to become a model for post-conflict inclusive governance. A model for building peace.

Now, Burundi once again teeters on the brink. In 2015, President Nkurunziza refused to step down at the end of his term, violating the new constitution and leading to a failed coup attempt – the aftermath of which has seen violent repression of the population.

Hundreds of thousands have fled, including much of civil society and a once-flourishing media. Torture, rape, imprisonment and extrajudicial killings are now commonplace, and in July 2016

the United Nations (UN) Security Council strongly urged all parties to cease and reject violence. The language of ethnic difference and the politics of ethnic scapegoating are once again coming to the fore, and tensions are extremely high.

For regional and international actors, such as the African Union (AU) and UN, which played key roles in the peace initiatives that paved the way for the 2005 elections, come familiar questions: what went wrong, and what to do now?

Through hundreds of interviews with everyone from government officials to local activists, AU and UN representatives, ex-combatants and aid workers, Dr Devon Curtis is exploring what happens when the lofty ambitions of peace programmes – the language of security and democracy – encounter, as she says, “African realities and politics on the ground”.

“Before I became an academic I worked with government and the UN and it was almost easier then to provide policy recommendations in broad bullet points. It’s not so easy now that I have a real sense of the complexities of a country like Burundi, based on extensive research,” says Curtis.

Her research, in collaboration with UK and African-based scholars, is revealing the myriad ways international peacebuilding is reinterpreted and distorted by the politics of post-conflict African countries.


“Various local groups attract attention, funds or delegitimise opponents by manipulating – or ‘instrumentalising’ – the simplistic categories set by international donor organisations,” she says. “This can lead to unintended consequences for international agencies.”

For instance, disarmament, demobilization and reintegration (DDR) of ex-combatants has become an integral part of international peace operations over the past 20 years and a key area of programmatic activity, yet even the very category of ‘combatant’ in DDR programmes is problematic.

“The international distinction between combatant and civilian doesn’t make much sense in Burundi, where many people have been both at different times. In fact, armed movements used DDR programmes as the basis for recruitment drives – promising potential recruits ‘attractive demobilisation packages’ from international donors.”



 **Words**
Fred Lewsey

 **Images**
Voluntary disarmament and demobilisation of combatants as part of the UN Operation in Burundi in 2004–2005

Credit: All images, United Nations Photo



In other cases, international actors keen to see regional stability and cessation of overt violence can be “instrumentalised” by a country’s ruling elites, such as in Burundi and its neighbour Rwanda, where funds and support were funnelled to the security services to increase the control and repression of populations.

“Grand ideas of democracy and empowerment can get lost in conversions towards militarisation that, on a short-term and basic level, meet with the international donors’ initial desire for security,” says Curtis.

International agencies have typically understood Burundi’s conflict to be along the same ethnic lines as Rwanda’s: the majority Hutu against the minority Tutsi.

These basic ethnic categories were deployed by internationals during peace talks, and ethnic power-sharing was promoted as the “anchor of the peace agreement”, says Curtis. “For a time, this succeeded in bridging ethnic divisions, as all political parties had to include representatives from each perceived ethnicity. However, it did not address other divisions in Burundi.”

“Also, at the time of the peace negotiations, inclusive power-sharing provided a perverse incentive to keep fighting if an individual or group didn’t

get what they wanted. Violence continued to be a way to get a seat at the table.” Armed groups would continue to splinter – creating more and more subgroups that would then demand representation in the peace negotiations. “As soon as someone was brought in, another movement would break away, forming a new faction.”

This was in part an effort to gain power, but there were also tactics to keep the peace talks going indefinitely, for financial gain. “Burundian representatives were flown to the city of Arusha in Tanzania for talks, and paid per diem rates.” There is a well-to-do neighbourhood in Burundi’s capital city nicknamed ‘Arushaville’, which is said to be built on the earnings of these protracted negotiations.

While the peace negotiations meant one thing for international and regional mediators and donors, they were viewed in different ways by Burundians. In fact, the very language of the international donor community can be coopted and reinterpreted for local gain.

For instance, networks of traditional elders, called the Bashingantahe, were considered a thorn in the side of the current regime in Burundi. “The regime implemented a ‘democratic decentralisation’ programme – something designed to appeal to donors – which established an elected government at the local level. It led to fierce competition between these newly elected local officials and the Bashingantahe elders, so the elders formed their own ‘NGO’ to appeal to international donors and to be able to attend donor-financed civil society forums.

“Everybody’s manoeuvring,” says Curtis. “These international ideas and labels are not imposed on a blank slate,



but are forced to interact with existing political and economic agendas.

“I wanted to focus on Burundi partly because there are few strategic and economic considerations for the international donor community – so one would assume that they are going in with relatively unbiased good intentions. Yet, even in this case, peacebuilding programmes do not bring about their intended effects. What does this mean for the even more ‘difficult’ cases such as the Democratic Republic of the Congo or Somalia?”

With funding from the British Academy, Curtis recently co-edited a book on peacebuilding ideas in different African contexts. She continues to consult with and advise the peacebuilding commission at the UN and the UK’s Foreign and International Development offices on a number of issues related to African peace and security.

Recently, in discussion with a network of African scholars, she has turned her attention to possible new approaches and ideas of peacebuilding: “International packages for peace tend to focus first and foremost on stability and electoral democracy, both of which are important, but which don’t affect the entrenched self-interest of ruling elites.

“Questions of social justice and equality are expected to come later – but what if it was flipped so they were prioritised? There are very few success stories in international peacebuilding, and I’m concerned we’re in danger of learning the wrong lessons: that peace is too problematic, and that we should focus on narrower goals of counter-insurgency.

“I’d like to try and shift the debate towards questions of social justice and international solidarity. If we changed the notion of what is important in peacebuilding, I wonder what peace might look like then?”



I Dr Devon E A Curtis
Centre of African Studies
and Department of Politics
and International Studies
dc403@cam.ac.uk

Working in a lab as a basic scientist can often seem far removed from the real world. But one researcher discovered that the skills he learned there would turn out to be surprisingly useful in fighting one of the most terrifying disease outbreaks of recent times.

On the windowsill of Professor Ian Goodfellow's office sit photographs of him with his children, and just down the corridor, his wife is carrying out research in the same department. Even at work, he is surrounded by constant reminders of the special things in his life, providing a sense of security.

His work, too – apart from the treadmill of seeking funding – is secure and safe. Goodfellow is a basic scientist, carrying out lab-based studies into

viruses such as norovirus, the winter vomiting virus. He doesn't even come into contact with norovirus patients, so he's at no particular risk of contracting this unpleasant, but relatively harmless, infection.

Yet in December 2014, Goodfellow chose to leave all of this security behind – for several months at a time – to join a taskforce fighting one of the most hazardous and frightening emerging infections of recent times, the Ebola outbreak in Sierra Leone. Since the epidemic began in West Africa in 2013 until it was declared over in March 2016, the virus infected more than 28,000 people and killed over 11,000.

Goodfellow was one of over 30 people from Cambridge, coordinated by Dr Tim Brooks at Public Health England, who lent their support.



Words
Craig Brierley

“Basic science can often feel removed from real-world applications”

CALL OF DUTY



Goodfellow helped set up one of the first diagnostic laboratories in an Ebola Treatment Centre near Makeni, in northern Sierra Leone, with support from the UK government. This was physically demanding and at times potentially dangerous work. “We had to move several tonnes of equipment and reagents by hand, in 35°C heat with over 90% humidity on a rather dangerous and very active building site,” he recalls. During their stay, they encountered fires and electric shocks, and one of his own postdocs was bitten by both a spider and a snake.

Since the start of the epidemic, Goodfellow and colleagues have sequenced over 600 Ebola genomes, helping to provide information about how the virus is evolving in, and how its evolution has been affected by, unprecedented levels of human–human transmission.

Towards the tail end of the epidemic, sequencing allowed researchers to trace the origin of new cases. “To end the epidemic, you need to make sure that any new cases are in transmission chains that are being monitored and are geographically contained, so you can pinpoint where this virus is coming from.”

The Tonkolilli District, for example, had been Ebola-free for several months when a new case occurred. “We needed to know if this new case had come from a new introduction from an animal host, from a neighbouring country, or if it was part of a chain of transmission that had been hidden from the healthcare providers. There’s a lot of stigma around Ebola, so it was possible there was a whole cluster in a village and that no-one was reporting the cases. That would be a disaster: all of a sudden, you don’t go from one to two cases, you go from one to tens or even hundreds.”

By sequencing the virus, in a very short time they were able to trace the source back to a survivor in whom the virus had persisted, and to take appropriate measures to prevent further spread. In fact, their work showed that Ebola can persist in survivors for over 15 months after infection and be transmitted through unprotected sex, and possibly even from a mother to her child through breast milk.

Now that the emergency has passed, the treatment centre has closed down, but its equipment is being used at the University of Makeni Infectious Disease Research Laboratory in a building donated by the country’s president, Ernest Bai Koroma. The Laboratory was kitted out with support from the Wellcome Trust and the Cambridge-Africa Programme, and

now functions as a base for local and visiting scientists to carry out research. Goodfellow and his postdoc Dr Luke Meredith have helped to train local technicians and researchers in some of the latest techniques in surveillance and sequencing of pathogens such as HIV and hepatitis B.

“We need to avoid ‘parachute science’, where scientists fly in, take samples and leave,” he insists. “It should be about developing sustainable partnerships, about developing local capacity. With training and support, local researchers have the ability to respond to these outbreaks; they just need the equipment and the infrastructure.”

This approach has already shown its value. A new case arose in January 2016 while neither Goodfellow nor any of his colleagues were in the country, but local scientists were able to use the techniques to trace the source of the infection.

Going to Sierra Leone was not an easy decision for Goodfellow, but he feels that he had a duty to respond. “The academic virology community had a responsibility to offer support. We couldn’t just sit back and watch this massive epidemic explode in front of our eyes with the knowledge that we have skills that could be useful.”

Many of the scientists who went out have struggled to return to their normal work, he says – some even quit their jobs on returning to take up more front-line jobs or to undertake more translational research. For Goodfellow, it has certainly made him appreciate the contribution that basic science makes.

“Basic science can often feel removed from real-world applications,” he says, “but the skills you gain from running a laboratory are actually very useful in these kinds of environments. The ability to think on your feet and to figure out solutions is invaluable.”

It has also given him some perspective about what he does. “The satisfaction you get from being involved in a response like this and in capacity building is orders of magnitude better than publishing academic papers.”



Professor Ian Goodfellow
Department of Pathology
ig299@cam.ac.uk

Dr Caroline Trotter
Department of Veterinary Medicine
ct56@cam.ac.uk

Belt buckles

Dr Caroline Trotter works on an infectious disease that has killed even more people than Ebola. It occurs periodically right across the ‘midriff’ of Africa from Senegal to Ethiopia, in the so-called Meningitis Belt.

In the last major meningitis outbreak, in 1996, some 250,000 people were infected and 25,000 died. It was at this point that the global health community came together to fight back.

The Meningitis Vaccine Project (MVP) was launched, a partnership between the international health organisation PATH and the World Health Organization (WHO). Working with the Serum Institute of India, the MVP developed and rolled out the meningococcal A conjugate vaccine in just 10 years to combat the particular strain that affected the African belt. Since its introduction in 2010, 265 million people have been vaccinated. In Burkina Faso, where the vaccine was first used, a mass vaccination campaign saw 10 million people vaccinated in 10 days.

But even campaigns as huge as this aren’t enough to eliminate the infection, as Dr Caroline Trotter from the Department of Veterinary Medicine explains: “You get a honeymoon period, but then you see a resurgence of cases.”

Trotter and her team used mathematical modelling to predict the best strategies for ensuring that this did not happen. The WHO, who funded her work, used it to shape their guidelines and ensure that the vaccine was introduced into routine vaccination programmes across sub-Saharan Africa.

She and Goodfellow were part of a Cambridge-Africa delegation to The Gambia in 2014 – a trip that inspired Goodfellow to lend support to combatting Ebola – and as a result Trotter is now working with collaborators at the Medical Research Council Unit in the country to look at the effects of the vaccine on pregnant women and their babies.

Meanwhile, she continues working with the African Meningococcal Carriage Consortium, a global research effort to study how meningococcal meningitis is spread in Africa, with the hope of gradually tightening the belt on this devastating disease.

Carriers of Culture



Words
Louise Walsh



Images
CGLI members visit the exhibition of 19th-century photographs (right) they co-curated



Credit: Josh Murfitt



When Reverend Kenred Smith captured moments of life in the Congo over 120 years ago, he couldn't have imagined the photos would be chosen by a Congolese community to help them remember a country that many of them had fled.

The community is a London-based group, the Congo Great Lakes Initiative (CGLI). Its members aim to help people with Congolese and African heritage, some of whom are victims of post-conflict trauma, better integrate in the UK. "One way for building confidence and skills has been to re-connect ourselves and our children to their heritage through museum collections," says Didier Ibwilakwingi Ekom, Executive Director of CGLI and project coordinator. "It's helping us to find new ways to tell our stories."

Reverend Smith's collection of 242 photographs is held at Cambridge's

Museum of Archaeology and Anthropology and now forms part of a collection that numbers around 650 images from the Congo Basin, many of them still on their original glass plates. In addition, the Museum has around 1,200 objects from the Congo, just under 400 of them associated with members of the Baptist Missionary Society.

With funding the CGLI raised from the Heritage Lottery Fund, its members have been working with Dr Chris Wingfield and others at the Museum to unlock new understanding of the images through its members' unique indigenous insights.

"During the 19th and 20th centuries, Britain was a major supplier of missionaries to Africa and around the world, many of them sending home materials from these early encounters," explains Wingfield. "Missionary collections have been under-researched and overlooked in Britain and yet histories of missionary activity can really



matter to people in these now strongly Christian parts of the world. One of our interests has been to understand who cares about this material today, in what ways, and how this can influence the ways we engage with collections.”

The Great Lakes region of Africa straddles the equator of the continent and in recent decades has suffered interlinked conflicts, famine, violence and refugee-related problems. In the Democratic Republic of Congo (DRC) alone, the war that officially ended in 2003 claimed up to six million lives, displacing over two million people.

“When refugees first arrive, questions of heritage are not necessarily the priority,” adds Wingfield. “But after 10 or 20 years there can be a search for connection and a desire to discover traces of shared histories. This group in particular has been very active in drawing out those aspects of Britain’s history that connect and crossover with the Congo.”

One CGLI member describes what the exhibition has meant to her and her family: “Involvement in political activities led to me fleeing my country. This exhibition has made me really proud that [information] can be passed on from generation to generation. I’ve got my grandson who is five years old and he keeps on asking me questions. He has learned, and in the future he can pass it to his brother, his siblings.”

Wingfield adds: “Re-engaging with the collection, identifying themes and then co-curating the exhibition with the community has been enlightening. This project has partly been about giving children who are growing up in London a link to their Congolese heritage. These kinds of collections are a resource they can draw on. But it’s also given the Museum a sense of the different ways people feel they have an ongoing stake in historic collections.”

Among the collection is a series of photographs showing women making kwanga, a manioc bread. It’s a laborious process. Manioc roots are harvested, then soaked, dried, sieved, boiled, pounded, wrapped, re-steamed and re-dried – the multistep process is needed to rid the starchy vegetable of its cyanide-like poison.

The community returned again and again to these images, and suggested they form the heart of the exhibition. “We looked at these pictures of women carrying huge baskets of manioc to market and we thought that’s really where the power lies – in those who sustain life,” explains Pamela Campbell, Vice Chair of CGLI. “That’s not to denigrate men. But keeping things going is powerful and that power lies with women.”

Kwanga is still an important part of Congolese life both in the DRC and in the UK. As Ibwilakwingi-Ekom says, “there is no single party where you won’t find kwanga... if there is none there has not been a party.”

Remarkably, women are still processing the vegetable almost the same way, a century on, as shown in contemporary photographs donated to the Museum by the CGLI. One photograph taken in the DRC shows a woman carrying the manioc she’s harvested, the effort etched on her face of hauling the heavy basket. It’s surprisingly similar to photographs taken in the 1890s by Smith; the basket is almost identical to one collected by Baptist Missionaries and given to the Museum in 1910, and which now forms the centrepiece of the exhibition.

For Wingfield and his colleague Dr Johanna Zetterström-Sharp, the project represents a “new path” for working with museum collections. “It’s really important to work with communities like the CGLI because they bring fresh approaches to the curation of objects,” she says. “We often think about our collections in relation to the disciplines that we come from but there are lots of other forms of knowledge and understanding that projects like this bring out, and our perspectives are shifted as a result.”

The community describes the partnership as one in which universities have the knowledge, but members have the information.

Ackys Kituba, President of the Congolese Community in the UK, adds: “Although we are educated, we are discovering new things about our country. The link will be stronger than before. We are learning something as a group but we are doing it for our children.”

Nine-year-old Enoch was born in the UK and travelled to Cambridge with his Congolese family to see the exhibition. Asked what he’d remember most, he says: “How they make kwanga. It was really interesting. It’s helping me find out more about my family. It’s kind of clever... they wouldn’t make it for no reason.”

‘Carriers of Culture: Women, Food and Power from the Congo Basin’ is at the Museum of Archaeology and Anthropology until 2 April 2017

<http://maa.cam.ac.uk/>

“It’s helping us to find new ways to tell our stories”



Things

Curious Objects

Asante gold weights

Among Cambridge University Library's extraordinary collection of around eight million books, manuscripts and digital holdings are some unexpected items, including a set of weights made by the gold-rich Asante people of West Africa.

Learning the correct way to weigh gold dust – sticky to the touch but easily blown away – was essential for the Gold Coast merchants who transported this universal medium of exchange across the Sahara. It required skill, together with miniature scoops, scales, boxes and standardised brass weights, like the ones shown here.

Cast in the form of animals, fish, insects, birds, musical instruments, weapons and status objects, the weights were an art form as well as tools of the trade. Their designs sometimes alluded to proverbs and folktales, and reflected wider Asante spiritual beliefs and cultural practices.

These particular items are among a set purchased from a Hausa trader by D M Lawson while he worked as a telegraph engineer in what is now Ghana between 1926 and 1932, and were later donated to the Royal Commonwealth Society.

The weights, along with many other curious objects – from an old boot, a boomerang and beard hair, to an ostrich feather and ectoplasm – are on show at the Curious Objects exhibition until 21 March 2017 at the University Library as part of its 600th anniversary year.

<https://exhibitions.lib.cam.ac.uk/curiousobjects>

Film available:
<http://bit.ly/2iAtsir>





Life sciences

- Ageing and neuropsychiatric epidemiology (Benin, Tanzania)
- Characterising *Campylobacter* from diarrhoeal patients and chickens (Botswana)
- Genetics of vaccine response (Burkina Faso)
- Genome diversity and health (Burkina Faso, Morocco, Namibia)
- Africa Partnership for Chronic Disease Research (Cameroon, Ghana, Nigeria, Tanzania, The Gambia, Uganda)
- ASPEN/INDIGO Consortium (Egypt, Morocco, Nigeria, Tunisia)
- Impact of climate change (Ethiopia, Kenya)
- Characterisation of *Pectobacterium* (Ghana)
- Improving nutrients in sorghum (Ghana)
- Medicinal plant extracts (Ghana)
- Antimycobacterial compounds in fungi (Ghana)
- Gene selection in Ashanti dwarf pigs (Ghana)
- Rotavirus strains in animals and humans (Ghana)
- *P. falciparum* and malaria (Ghana)
- Drug resistance in malaria (Ghana)
- Genomics of infectious pathogens (Ghana)
- Rice husk biochar (Ghana)
- Cabbage aphids and disease (Ghana)
- Genetics of *E. carotovora* (Ghana)
- Nematode-susceptible tomatoes (Ghana)
- Cultivation of *C. sanguinolenta* (Ghana)
- Metabolites in *M. ulcerans* infection (Ghana)
- Characterising marine bacteria (Ghana)
- *Listeria* in dairy products (Ghana)
- Developing all-season tomatoes (Ghana)
- Genetics of susceptibility to parasites (Ghana)
- Evolution of epidemic cholera (Ghana)
- Plant viruses (Ghana)
- Noroviruses (Ghana)
- Blood transfusion (Ghana, Guinea, Sudan)
- Trypanosomes in cattle (Ghana, Kenya)
- *S. aureus* in humans and livestock (Ghana, Kenya, Tanzania)
- Human and animal viral infections (Ghana, Uganda)
- Wild rice MAGIC (Ghana, Uganda)
- Soil testing for farmers (Kenya)
- Mosquito phytochemicals and malaria (Kenya)
- Tick-borne zoonotic disease (Kenya)
- Biting flies and trypanosomiasis in cattle (Kenya)
- Biological research travel grants (Kenya, Nigeria)
- Paediatrics (Kenya, Nigeria)
- Biological science research training workshops (Kenya, Nigeria, S. Leone, Tanzania, Uganda)
- Malaria transmission, severity and resistance (Kenya, Uganda)
- Plant-aphid interactions (Kenya, Uganda)
- Dynamics of infectious disease (Libya, Uganda)
- Environment, poverty and human health (Madagascar)
- Fisheries-induced evolution (Malawi)
- Elephant relationships (Mozambique, S. Africa)
- Sexual networks, STDs and HIV (Rwanda)
- Breast milk and infancy growth (S. Africa)
- Cellular signalling (S. Africa)
- Detecting diabetic complications (S. Africa)
- Coastal invertebrate ecology (S. Africa)
- Genetics of petal patterns (S. Africa)
- *Leishmania* in dogs (Sudan)
- Nutrition, disease, growth and poverty (Sudan)
- Trachoma Control Programme (Sudan)
- Pulmonary arterial hypertension (Sudan)
- *S. haematobium* infection (Tanzania)
- Sustainable agricultural practices (Tanzania)
- HIV and *S. mansoni* co-infection (Tanzania)
- HIV, TB and viral hepatitis clinical trials (Tanzania)
- Ecosystem services (Tanzania)
- Cambridge Development Initiative (Tanzania)
- Micronutrients in pre-pregnancy (The Gambia)
- Maternal health, nutrition and sex education (Uganda)
- Characterising traditional medicine (Uganda)
- Reintegration post-conflict (Uganda)
- Modelling human HIV infections (Uganda)
- Natural killer cells in pre-eclampsia (Uganda)
- Immunology of helminth infections (Uganda)
- Genetics of pre-eclampsia risk (Uganda)
- Rotaviruses (Uganda)
- War-affected youths (Uganda)
- Characterising breast cancer (Uganda)
- High fertility rates (Uganda)
- Cervical cancer (Uganda)
- Prevention of medication errors (Uganda)
- Acute respiratory distress syndrome (Uganda)
- Zika virus (Uganda)
- Pulmonary fungal infections and severe asthma (Uganda)
- Vitamin D in TB infection (Uganda)
- Immunology of maternal health (Uganda)
- Evolutionary ecology of African birds (Zambia)
- Kenya, S. Leone
- Violent biblical texts and peacebuilding (Burundi, Uganda)
- Bilingual language education (Cameroon)
- Dzanga National Park (Central African Republic)
- Faith, health and well-being (DR Congo)
- Missionary archives (DR Congo)
- Amarna project (Egypt)
- Young Muslim leaders (Egypt)
- Cambridge Inter-Faith Programme (Egypt)
- Education leadership and best practice (Ethiopia, Ghana, Rwanda)
- Death penalty and the rule of law (Ghana)
- Education research training (Ghana)
- Gated communities (Ghana)
- Urban growth (Ghana)
- Africa's Voices (Ghana, Kenya, Malawi, Mozambique, S. Leone, Somalia, Tanzania, Uganda, Zambia)
- Education curriculum and quality assurance (Ghana, Uganda)
- Molecular history and adaptation of minority tribes (Kenya)
- Christianity, displacement and migration (Malawi, Mozambique, Zambia)
- Centre of Islamic Studies (Morocco)
- Improving lives of the impoverished (Niger)
- Archaeology and anthropology collections (Nigeria)
- Business associations and policy (Nigeria)
- The developmental state (Rwanda)
- Economic transformation (Rwanda)
- Post-conflict citizenship (Somalia)
- Educational technologies (S. Africa)
- Education methods and university curriculum reform (S. Africa)
- Mapungubwe Interpretive Centre (S. Africa)
- Iron Age archaeology (S. Africa)
- Gender stereotypes in oral literature (Uganda)
- Protest movements and governance (Uganda)
- Gender and mathematics (Uganda)
- The East African Literature Bureau (Uganda)
- Human resources in local government (Uganda)
- Forestry, biodiversity and tourism (Uganda)
- Homosexuality and the media (Uganda)
- Educating students affected by war (Uganda)
- University-school partnerships: teacher mentoring (Uganda)
- Language research (Uganda)
- Pentecostal-charismatic spirituality (Uganda)
- Income mobility and welfare (Uganda)
- Oral media in rural areas; folktales (Uganda)
- Teaching of agriculture (Uganda)
- Education quality assurance (Zimbabwe)

Physical sciences and technology

- Developing AUC research centre (Egypt)
- Oil spill environmental remediation (Ghana)
- Graphene-based solar cells and optical waveguides (Ghana)
- Testing drugs for bioactivity (Ghana)
- Remote sensing techniques (Ghana)
- Nucleic acid diagnostics (Ghana)
- Electro-porcelain composites (Ghana)
- Heating probe for cancer treatment (Ghana)
- Rainforest ecology (Kenya)
- Analysing large-scale UMTS network usage (Kenya)
- Technology based on mobile platforms (Kenya)
- Tropical rainforests (Madagascar)
- Industrial sustainability (Nigeria)
- Pseudocapacitors for grid storage (Nigeria)
- Road construction (Nigeria)
- African Institute for Mathematical Sciences (Senegal, S. Africa)
- Square Kilometre Array (S. Africa)
- Telescope calibration techniques (S. Africa)
- Sensing technology for bridges (S. Africa)
- Low-energy materials (S. Africa)
- Sustainable dairy production (Uganda)
- Solar technology and social enterprise (Uganda)
- Mobile money technology (Uganda)
- Oil-led development outcomes (Uganda)

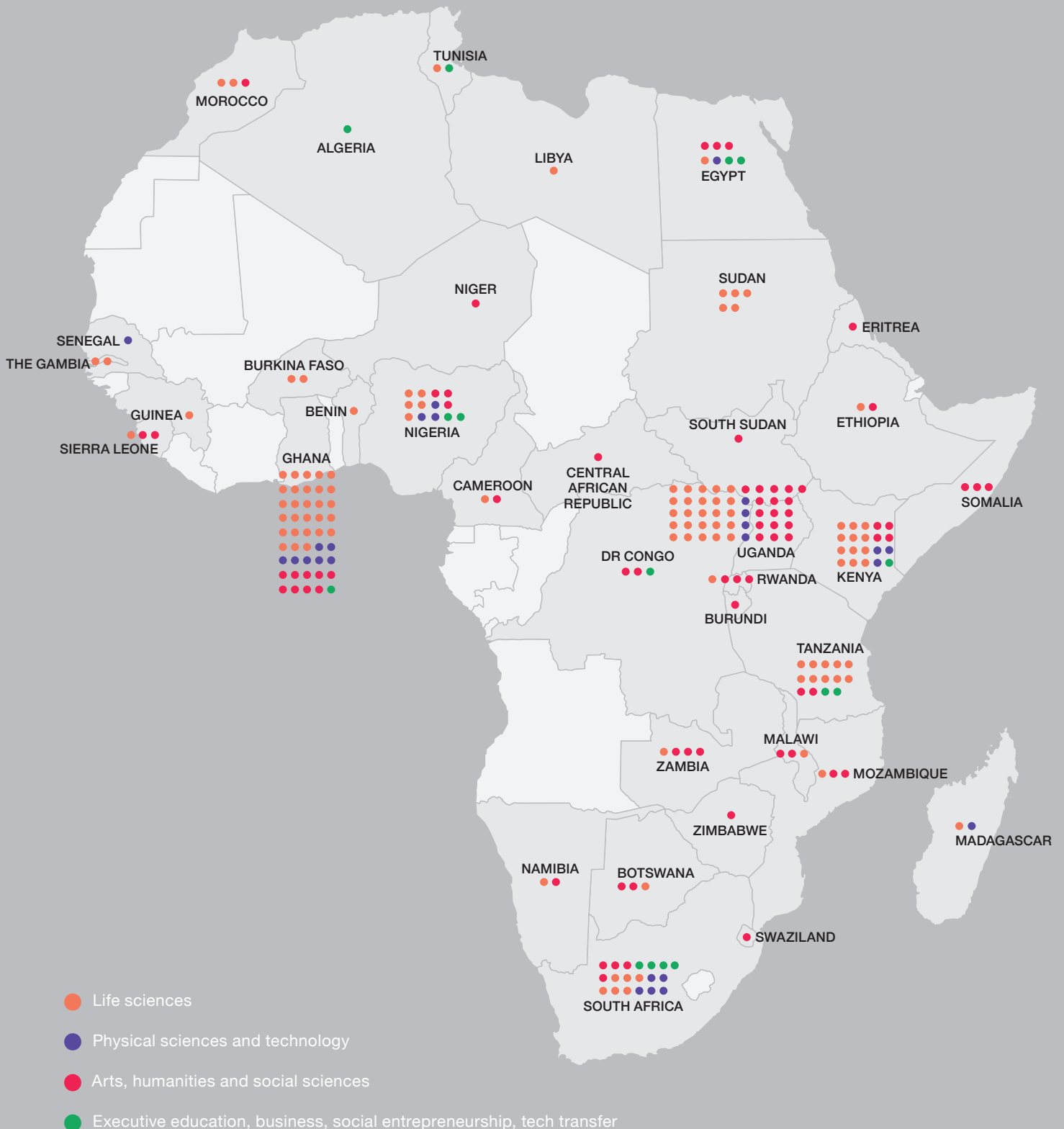
Arts, humanities and social sciences

- Advanced Leadership for Learning Network (Botswana, Eritrea, Ghana, Kenya, Namibia, Nigeria, Somalia, S. Sudan, Swaziland, Tanzania, Zambia)
- African Heritage Challenges (Botswana, Ghana,

Executive education, business, social entrepreneurship, tech transfer

- Cambridge Enterprise (Algeria, Tunisia)
- Judge Business School Executive Education (DR Congo, Nigeria, S. Africa, Tanzania)
- Women entrepreneurs (Egypt)
- Cambridge University Press (Egypt, S. Africa)
- Cambridge International Examinations (Ghana, Kenya, S. Africa)
- Cambridge Institute for Sustainability Leadership (Nigeria, S. Africa)
- Cambridge Development Initiative (Tanzania)

Cambridge's engagement with Africa*



* This map is indicative of Cambridge's wider engagement with Africa. For details of the Cambridge-Africa Programme, see p. 20.

CAMBRIDGE-AFRICA PROGRAMME

Partners in **58** African institutions, across **26** countries, with **2** regional hubs in Ghana and Uganda



Next generation

Over 200 Cambridge collaborators



Supporting 40 African PhD students



and 72 African post-doctoral researchers



Over 120 publications by African fellows

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funding from the University of Cambridge

£6.9m

in external funding to the Programme

£21.95m

in external funding to African partners

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30+ **FIELDS OF RESEARCH**



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Cambridge-Africa is Cambridge's university-wide institutional structure to make its expertise, resources and influence available to support African researchers working in Africa on African priorities.



Words
Louise Walsh

Having the chance to contribute to the pool of human knowledge depends a great deal on where you live in the world.

Opportunities are skewed in favour of those who are better resourced, who have better access to education and to the internet; it accelerates in places where researchers receive world-class training and then pass their expertise on to the next generation of young researchers.

Knowledge lies at the heart of social and economic development, so countries with a thriving knowledge economy and good research infrastructure develop quicker; and the gap between those that don't have these advantages grows ever wider. Among those lagging behind are many of the African countries.

And yet, explains Professor David Dunne, Africa has excellent researchers. He knows because for 30 years he's been working in Africa with African colleagues on neglected tropical diseases: "I realised that they were brilliant but they didn't have the opportunities they deserved to make their unique contribution both to solving Africa's challenges and to adding to the sum of global knowledge.

"Even in the best African universities, there is a chronic shortage of researchers with access to the resources they need to be internationally competitive and to mentor future researchers," he explains. "There just aren't enough of them."

"In parts of Africa, sometimes the choice seems to be between prioritising universal access to a basic education or investing in tertiary education and research scholarship. In reality, there is no choice," says Dunne. "Both are absolutely essential."

Eight years ago, he realised that universities like Cambridge could help bridge this resource and mentorship gap in Africa in ways that would build research capacity "while avoiding the loss of indigenous talent that so often occurs when better opportunities are available outside of Africa."

Cambridge-Africa is the result. Today, the Programme supports African researchers in 58 different institutions in 26 countries across the continent. Its various schemes link PhD, postdoctoral and group leaders

with a network of over 200 Cambridge-based researchers.

Key to its success is a 'matchmaking' model of partnership, as Dr Pauline Essah explains: "We carefully match the research interests of African and Cambridge researchers. It means there are benefits for both parties, and the potential for equitable and sustainable long-term collaboration after the mentorship has finished."

She adds: "Being an African myself, and having studied in an African university before studying and working in Cambridge, I know that it wouldn't work if we were just trying to take what Cambridge has and plant it in Africa. Instead we are modifying and adapting it in response to the needs identified by our African colleagues."

"Universities are not just luxury items for wealthy societies"

Dunne and Essah began with targeting research in health: "We saw this as an easy win on both sides – it meets one of Africa's greatest challenges, and it gives wider geographic scope to Cambridge researchers."

They were surprised however by the scale of the response: "We were pushing against an open door," says Dunne. Soon, scholars from archaeology to zoology, engineering to English, politics to plant sciences were joining the scheme. In 2015, the Programme was adopted as the University of Cambridge's official international strategy to support African academia across all subject areas.

"And of course this is good for Cambridge too," says Dunne. "It means our researchers have greater opportunities to collaborate globally and our students can experience working in Africa. It has helped make Cambridge a truly international University."

Speaking at the annual Cambridge-Africa Day symposium, Cambridge's Vice-Chancellor Professor Sir Leszek Borysiewicz said: "The speed

with which the Cambridge-Africa Programme has developed is phenomenal. We are trusted by our partners, and the Programme has buy-in from our academic community. This has been essential to the programme's success. Today, it is no longer something done by a handful of enthusiasts. It is now something embedded in the University's DNA."

Adds Dunne: "The first of the Cambridge-Africa fellows are now starting to fulfil their outstanding potential as researchers and leaders, providing mentorship to the next generation of young African researchers." To date, all 54 of the African PhD and postdoctoral researchers who have completed their fellowships are still working in sub-Saharan universities or research institutions.

"Universities are not just luxury items for wealthy societies," he says. "They are equally vital to the futures of low- and middle-income countries if those countries are to share in the advantages of knowledge creation."

Cambridge-Africa fellowship schemes are funded by the Wellcome Trust, the ALBORADA Trust, the Isaac Newton Trust and the Carnegie Corporation of New York.

I **Professor David Dunne**
Director, Cambridge-Africa Programme
dwd10@cam.ac.uk

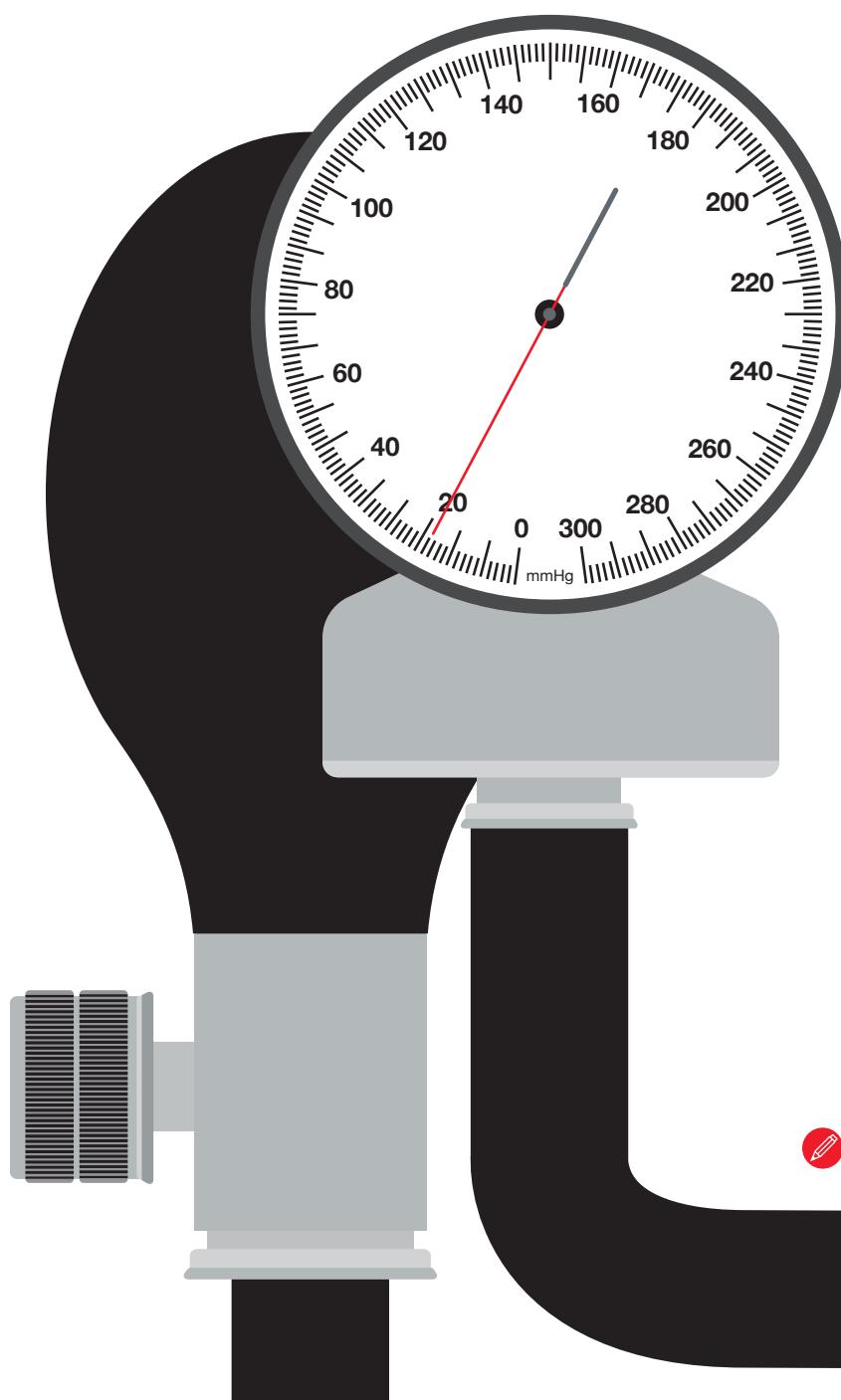
Dr Pauline Essah
Manager, Cambridge-Africa Programme
pae21@cam.ac.uk

Fellowship schemes

- ALBORADA Research Fund
- Cambridge-Africa Partnership for Research Excellence (CAPREx)
- Cambridge-Africa PhD Scholarship Scheme
- Makerere University/Uganda Virus Research Institute Infection and Immunity Research (MUII)
- Training Health Researchers into Vocational Excellence (THRiVE)
- Wellcome Trust-Cambridge Centre for Global Health Research

Under pressure: the battle to have a baby in Africa

The number of women who develop fatal complications during pregnancy and childbirth is so high in Africa that, in some cultures, women equate giving birth with going into battle.



Words
Louise Walsh

A complication of pregnancy that causes the mother's blood pressure to rise – often fatally – is more common in women of African descent than any other. Research in Uganda by African and Cambridge researchers is helping to uncover why.

As a young doctor in Uganda a few years ago, Dr Annetee Nakimuli was told that nothing could be done about a complication of pregnancy that was putting thousands of pregnant women a year at risk of death.

She remembers the frustration: "I felt like we were accomplices in this war of sorts. People say we do not remember the words of our enemies but the silence of our friends. I did not want to accept that it was beyond hope."

The disease is pre-eclampsia, a condition that is thought to be caused by the placenta developing abnormally. Women with pre-eclampsia often experience very high blood pressure, which can be fatal without medical intervention. Although the condition affects women worldwide, in African women it is more common and particularly severe. It also occurs earlier in pregnancy and can recur in subsequent pregnancies.

"What makes pre-eclampsia such a challenge is it has been impossible to predict or prevent," explains Professor Ashley Moffett, from Cambridge's Department of Pathology and Centre for Trophoblast Research, who is an expert on the disease.

"It's been called the 'silent killer' because many women cannot feel the danger sign that their blood pressure is rising until it's too late. Even when it is detected the only course of action is constant monitoring, and ultimately the only cure is delivery – sometimes at too early a stage for the baby to survive," adds Moffett.

Nakimuli knows only too well the difficulties that African women face. Today she's an obstetrician in Mulago Hospital, Kampala, where 33,000 babies are born each year. It has the highest number of live births of any hospital in the world (around 100 per day), and 15% of pregnancies develop life-threatening complications such as pre-eclampsia, haemorrhage, obstructed labour and sepsis. She describes herself and her colleagues as being "on the front line" in the battle against death in pregnancy and childbirth.

"I would often see women who had had four or more Caesarean sections with

no living child – they continued exposing themselves to the danger until they had a baby," says Nakimuli, who is also a lecturer at Makerere University. "I felt like not sitting back and just saying this is a disease with theories."

Seven years ago, she began work with Moffett through the Cambridge-Africa Programme, first as a MUII PhD fellow registered at Makerere University, then as a MUII postdoctoral fellow and now as a research collaborator. Based in Kampala throughout, she would periodically travel to Cambridge to learn new techniques, analyse samples and spend time with Moffett trying to unravel why a complex disease is so much worse in Africa.

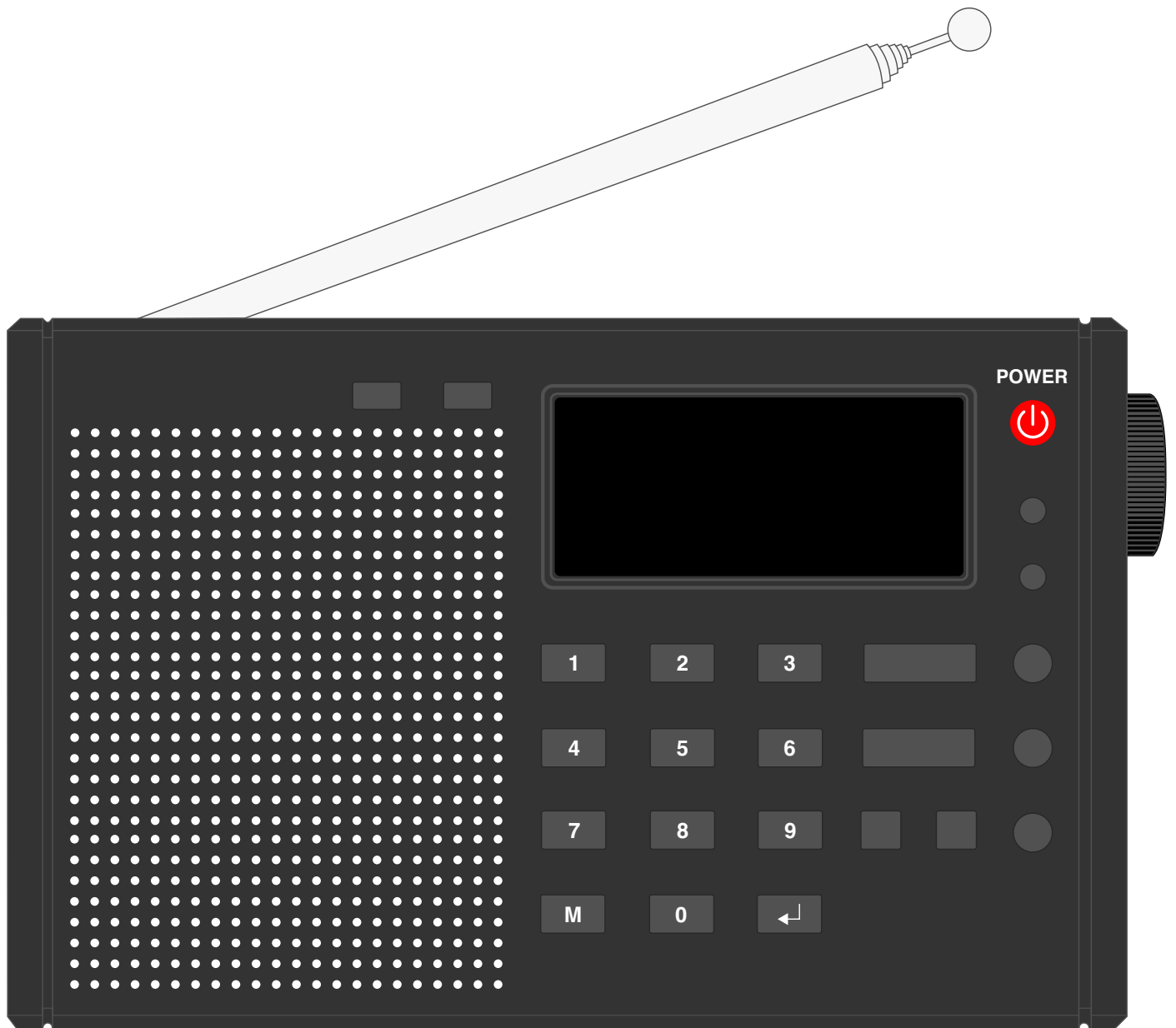
A few years earlier, Moffett had discovered that, when the placenta is formed, a remarkable 'boundary-setting' process occurs between the mother and the fetus deep within the lining of the womb.

"The placenta must invade the mother enough to access nourishment for the growing baby, yet not so much as to penetrate through the uterus," she explains. "Placentation is a setting up of the territorial boundary between two genetically different individuals – the mother and her baby, who carries genes from the father. It needs to be in exactly the right place for both to survive and thrive."

Moffett found that maternal immune cells called uterine natural killer cells mediate the compromise between mother and baby. These cells have unique proteins on their surface called killer-cell immunoglobulin receptors (KIRs), which recognise proteins called MHC on the invading fetal cells. Certain combinations of maternal KIR genes and fetal MHC genes are associated with pre-eclampsia, whereas other KIR genes appear to protect against the disease.

But why would women of African descent suffer so much more from pre-eclampsia than other women? "There was an assumption in Africa that there was a socioeconomic reason, like poverty," says Nakimuli. "I was convinced that there was something biological."

Nakimuli set about recruiting 750 mothers at Mulago Hospital to what is the largest genetic study of pre-eclampsia conducted in Africa. She collected blood and umbilical cord samples and, in Cambridge, 'typed' the DNA to look at all the genetic variation.



“It was kind of a high-risk project, but my determination kept my hope alive. I wanted to find big things.”

Her hunch proved right. She found that the KIR genes that protect African women against pre-eclampsia are different from those that protect European women. Moreover, the risky combination of maternal KIR and fetal MHC proteins occurs at a much higher frequency in sub-Saharan Africa than anywhere else in the world.

The findings immediately opened up new avenues of research into the biology of pre-eclampsia. The study also has implications for understanding infectious diseases, as Moffett explains: “We think that women of African ancestry may have these risk genes because of certain beneficial selective pressures, otherwise why would genes that kill mothers and babies be so common in the population? People with the gene that causes sickle-cell

anaemia are able to fend off malaria – perhaps something similar is happening for KIR genes? And so now we are starting work to see whether the genes are protecting against infections such as measles, HIV and malaria.”

While Nakimuli and Moffett continue pinpointing the genetic basis of pre-eclampsia, and hope to bring out the first comprehensive textbook on African obstetrics, they are aware that one of the key issues surrounding pregnancy is that too many African women go to hospital too late, leaving it until their complications are advanced and dangerous.

“There’s a general lack of awareness and understanding,” explains Nakimuli. “There isn’t even an Ugandan word for pre-eclampsia. The closest people get to describing the condition is ‘having hypertension which is different from the other hypertension when you’re not pregnant’. It becomes a mouthful.”

Last year she took part in a series of radio programmes in Uganda as ‘Doctor Annettee’, the on-air doctor ready to answer questions from the audience. The programmes were part of an innovative Cambridge-led research project, ‘Africa’s Voices’, which uses interactive radio and mobile communications to gather and analyse the views of ordinary citizens.

“Because of the high rates of maternal mortality, a coping mechanism among Ugandan women is to consider pregnancy as being about bravery and fortitude,” says Nakimuli. “This way of coping might however lead to late self-diagnosis of the warning signs.”

“Sociocultural beliefs like coping mechanisms will determine how people behave,” says Dr Sharath Srinivasan, who is Head of Cambridge’s Centre of Governance and Human Rights and leads Africa’s Voices, “and so it’s important to understand a person’s

thinking to support better maternal and neonatal health policies.”

However, the challenge has always been how to collect and assess all of the different ‘voices’ from hard-to-reach African communities. Srinivasan and colleagues realised that Africa’s digital revolution – particularly the widespread use of mobile phones and SMS messaging – could provide the answer when combined with the huge popularity of local radio stations and the team’s technical know-how.

The team developed a format in which a radio presenter would play a real-life testimonial – such as a woman relaying the complications of her pregnancy – and then invite listeners to reply to a related question by sending a text to a toll-free number. Each respondent would subsequently receive an SMS sociodemographic survey to complete.

“What makes this set-up so rich is the fact that ordinary citizens are encouraged to voice their views. They aren’t restricted by a poll-style yes/no answer,” says Srinivasan. “We’ve developed a methodology that can take this data, which is often complex, unstructured and in more than one local language, and analyse it with qualitative social science and computational techniques to draw out key themes and insights.”

During Africa’s Voices pilot phase, the team used this format in eight sub-Saharan countries, working with nine radio stations, and choosing radio presenters who have a good relationship with their audience. In these ‘social spaces’, they probed beliefs on HIV/AIDS, vaccination, women’s issues, agriculture and governance processes.

Now spun-out of the University as a non-profit organisation, Africa’s Voices works in East Africa with NGOs, health agencies and media organisations, and maintains strong links with researchers such as Nakimuli and Moffett.

An interactive radio project to shed light on pregnancy complications like pre-eclampsia was recently completed with three local language radio stations in Kampala, Uganda, and rich insights emerged into the perceived causes of complications in pregnancy. One finding is the difference in beliefs between men and women.

“Men, more than women, tend to think that the causes of complications are related to enduring traits of the mothers – their biology or their personality – but that the risk of complications is more likely to happen to other women, not their own partner,” explains Srinivasan.

“Women on the other hand are more likely to believe that complications arise

because of factors that they can control – such as their lifestyle. Both women and men agree that insufficient health provision is the major reason women delay seeking healthcare.”

Srinivasan suggests from his experience that governments and service deliverers are keen to listen intelligently to what people are saying and to organise their work more attentively to the world views and collective beliefs of the populations they serve. “Sociocultural beliefs that limit the seeking of healthcare are addressable,” he says. “Interventions that engage women and communities in conversations can help change beliefs, opinions and norms, and thus behaviour patterns.”

“It was kind of a high-risk project, but my determination kept my hope alive. I wanted to find big things”

When Nakimuli is asked what her own research findings on the genetics of pre-eclampsia will mean for the mothers she sees every day on the wards at Mulago hospital, she is pragmatic.

“Can it help medically? We are still far from that,” she says. “Yes, theoretically we can predict risk by genotyping pregnant mothers, but we are in a low-resource setting – everything needs to be cost-effective. Really we need to develop a bedside test that doesn’t require costly and time-consuming laboratory analysis. Then we could know which women need to be monitored carefully.”

In the seven years since Nakimuli first embarked on her studies to understand why so many women die in pregnancy, Cambridge-Africa research partnerships with Mulago Hospital have widened considerably. They now include pharmacist Dr Ronald Kiguba and Professor Sheila Bird OBE (Medical Research Council Biostatistics Unit, Cambridge) investigating how to report medication errors and adverse drug reactions; microbiologist Dr David Kateete and Professor Stephen Bentley (Wellcome Trust Sanger Institute)

tracking how infections like MRSA spread through hospitals; and a group of obstetricians and midwives from Cambridge University Hospitals NHS Foundation Trust looking at best practice with their contemporaries in Kampala.

Meanwhile, a typical day at Mulago Hospital will bring around five pre-eclamptic pregnancies and several cases of obstructed labour, preterm birth and stillbirths; and a team of five doctors will be supervising 80–100 deliveries.

Funds are being sought by Cambridge-Africa to help set up an African Centre of Excellence in Pregnancy and Childbirth at Mulago Hospital, in partnership with Makerere University’s College of Health Sciences. “We would like to train more specialised staff who in turn will train the next generation, and we want to turn new understanding of pregnancy complications into clinical interventions,” explains Nakimuli.

Looking back to when she decided not to accept that nothing could be done about pre-eclampsia, Nakimuli says: “I was convinced that the reason we didn’t know much about the disease was because we’d been looking in the wrong place. We needed to study the disease in Africa. After all, if you want to study a disease properly, then you should look at the population most affected by it.”

Dr Annettee Nakimuli was funded by the Makerere University-Uganda Virus Research Institute Infection and Immunity Research Training Programme (MUII).

www.africasvoices.org


I **Professor Ashley Moffett**
Department of Pathology and
Centre for Trophoblast Research
am485@cam.ac.uk

Dr Annettee Nakimuli
Department of Obstetrics
and Gynaecology,
Makerere University, Uganda
anakimuli@chs.mak.ac.ug

Dr Sharath Srinivasan
Centre of Governance and
Human Rights, Department of
Politics and International Studies
ss919@cam.ac.uk

THE BIBBLE

AS A WEAPON OF WAR

 Words
Stuart Roberts

“Kony says it is God who sent him to kill people so nobody should stop him. You know this thing is very difficult to understand as Kony refers us to the Bible... In Kony’s time, God has sent the Holy Spirit, and it is the one which is doing the work through Kony”

Zacchaeus, a former LRA commander

In 2012, one of the world’s most wanted war criminals, Joseph Kony, became one of the most repeated names on the planet thanks to a YouTube documentary (*Kony 2012*) and a call to action that sought to expose the terror and slaughter he inflicted on thousands of men, women and children in Central Africa.

Indicted by the International Criminal Court for crimes against humanity, Kony is now believed to be in hiding with his followers. He remains the genocidal leader of the murderous Lord’s Resistance Army (LRA) who claimed to

have been sent by God to liberate the people of Northern Uganda from the rival National Resistance Army (NRA). From the start of their insurgency in 1987, Kony’s LRA claimed as their major objective the establishment of a government based on the Ten Commandments.

In the decades since, his army – often made up of thousands of forcibly conscripted child soldiers – have wounded, widowed and orphaned indiscriminately as they prosecuted a campaign of violence with a vigour befitting Kony’s vengeful readings of the Old Testament.

In the process, the LRA are thought to have displaced as many as two million Ugandans, the vast majority from Uganda’s Acholiland, where Kony originally hails from.

Today, Acholiland is a haunted place; haunted by the ghosts and memories of a recent past that has been written in blood rather than ink during nearly two decades of conflict.

But what happens when former LRA soldiers, those who have used the Bible as a weapon of war, return home from the front lines? How do former soldiers – male and female, adults and children –



learn to reread and reinterpret scriptures that once spoke to them of fire and brimstone?

This is the puzzle facing Dr Helen Nambalirwa Nkabala from Makerere University in Uganda. As a CAPREx fellow, she spent time in Cambridge working with Dr Emma Wild-Wood, from the Faculty of Divinity and the Cambridge Centre for Christianity Worldwide.

Nambalirwa Nkabala interviewed returning LRA soldiers in Uganda in order to examine how a positive engagement with biblical texts – especially those that seem to support violence – can help to promote peace instead.

She says: “My project identifies difficult texts in the Old Testament and seeks to identify the means by which they can be used in a constructive and meaningful way – with the central focus being on whether a particular interpretation promotes human dignity or not.

“The way the LRA used the Bible, in a literal sense, to justify their violent actions has caused a complete overturn of the social and generational structures of the Acholi people.

“The former LRA members I interviewed claim that all their actions are in accordance with Bible teachings; obedience to the law meant that anyone considered to have broken the Ten Commandments had to be destroyed.”

Kelly, a former child soldier, told Nambalirwa Nkabala that the Bible teaches that ‘somebody who does

“When you look at what happened in the north and you go to the Bible and you read from the beginning to the last part you may find that 90 per cent of what happened here is in the Bible. Whatever has happened is exactly how God designed it”

Steve, a former LRA commander

not obey must be killed’. This is the level of indoctrination that Cambridge researchers are trying to untangle as they work alongside Acholi leaders of varying denominations to promote peace and reconciliation using texts that were once wielded to justify murder on an industrial scale.

However, their work is complicated by the fact that Acholi cultural beliefs – as well as some readings of the Old Testament – also permit killing in exceptional circumstances, meaning that the LRA may have appropriated elements of Acholi culture to justify their own murderous ideology. For instance, the Acholi Chief and elders can pass *ngolo kop me too* – or ‘judgement of death’ – where killing is permitted. Likewise, Kony, a former altar boy in the Catholic Church, was brought up by a catechist father whom Nambalirwa Nkabala believes exposed him to Old Testament passages of death and punishment from an early age.

“Former LRA soldiers must be ready to reread the texts they were exposed to in a different way,” adds Nambalirwa Nkabala. “Texts with a violent message should be read with an ethical and nonviolent stance. Rather than passively accept what the text says, we must engage in dialogue with it. It is every Christian’s duty to expose and challenge any textual message which permits violence.

“The Bible must be read contextually. By asking about the role of the text to a particular context, interpreters will automatically be pushed into the habit of checking what implications a particular reading/interpretation could have on a particular community.”

Wild-Wood met with Christian and Muslim leaders of the Acholi Religious Leaders Peace Initiative (ARLPI) during her trip to Uganda in 2015 as she sought to understand how the Bible is now being used to rebuild society. She was struck by the commitment to peace across differing faiths and denominations.

“A great deal of thought has gone into how former combatants can be rehabilitated,” says Wild-Wood. “From my focus groups, the religious leaders were optimistic about the future, but the challenges are many. They are dealing with people who are very traumatised. Some see the LRA soldiers as perpetrators, some see them as victims. But there is a recognition that people have dealt with awful situations – and may fall apart afterwards.”

Wild-Wood says that the ARLPI’s initial desire to publicise the atrocities being carried out by the LRA – and to protect civilians where possible – has

Haunted by the ghosts and memories of a recent past that has been written in blood rather than ink

now refocused to aid the process of reintegrating former combatants, and is working alongside international charities like World Vision to facilitate the transfer of former LRA soldiers from reception centres back to their communities.

“Projects of post-war reconciliation often engage with traditional beliefs and customs in order to effect lasting peace,” adds Wild-Wood. “Acholi land is no exception, and Acholi practices have been utilised in restoring human relations. However, in the LRA and the wider population there are many Christians and a significant number of Muslims. It is important to engage the beliefs of those religious traditions when working towards long-term solutions to the destruction of society.”

While there may be a distance yet to travel, Nambalirwa Nkabala remains optimistic about Uganda’s future as it seeks to heal the deep scars caused by Kony and the decades of division and war he brought to his country.

“The advantage in all this is that the Acholi have a deep sense of community and solidarity,” she says. “This is exemplified in the various means they use to reincorporate wrongdoers back into their community. If the Acholi communities can be encouraged to maintain their cultural values of healing and reconciliation – even while reading texts that may have a violent message – then they can in the future avoid situations that can lead to the destruction and erosion of these most important of values.”

Dr Helen Nambalirwa Nkabala was funded by the Cambridge-Africa Partnership for Research Excellence (CAPREx) and The ALBORADA Trust, through the Cambridge-Africa Programme.

I Dr Helen Nambalirwa Nkabala
Makerere University, Uganda
hncabala@chuss.mak.ac.ug

Dr Emma Wild-Wood
Faculty of Divinity
ew273@cam.ac.uk

Africa's food requirements, along with its population, are growing fast. Three research programmes ask how a better understanding of viruses, parasites and the spread of disease can pave the way to improving agricultural yields.

The humble cabbage, universally despised by British schoolchildren, has found unexpected popularity on another continent. But just as the people of Ghana have developed an appetite – and a market – for this leafy green, so too has something else: a virus carried by aphids that causes the cabbages to wilt and die.

By contrast, a parasite that emaciates cattle across sub-Saharan Africa has been around for thousands of years but continues to take its toll on certain species of the animals it infects. Prominent ribs are the frequent hallmarks of trypanosomiasis – caused by the presence of a cunning parasite that evades the animal's immune system by periodically changing its protein 'coat'.

OF Meanwhile, farmers in Ethiopia are turning away from the traditional zebu cattle towards breeds that produce greater quantities of milk. As a result they are exposing their herds – and themselves – to increasing levels of tuberculosis (TB) that are brought about by intensified animal husbandry practices.

What links cabbages and cows are three programmes that hope to connect fundamental research with improving farm yields, and in so doing contribute to

COWS

solving a looming pan-African problem. More than half of global population growth between now and 2050 is expected to occur in Africa. And more people means a requirement for more food.

Ethiopia, for example, has the largest livestock population in Africa but, with a growing population and increasing urbanisation, even its 53 million cattle are not enough. And now efforts to intensify

farming in the country are bringing a significant health concern. "The new breeds are more vulnerable than zebu to bovine TB," explains Professor James Wood from Cambridge's Department of Veterinary Medicine. "This may have health implications for those who work with and live alongside infected cattle, and also raises concerns about transmission



to areas with previously low TB."

Wood leads a £2.9 million research programme, ETHICOBOTS, which is looking at the feasibility of control strategies, including cattle vaccination. The programme combines partners in eight Ethiopian and UK institutions, and brings together veterinary scientists, epidemiologists, geneticists, immunologists and social scientists.

"We need this mix because we are not only asking how effective strategies will be, but also whether farmers will accept them, and what the consequences are for prosperity and wellbeing."

AND

The difference that increasing productivity can have on farmers' livelihoods is not lost on an insect expert at the University of Ghana, Dr Ken Fening, who is working on another food-related research project. Cabbages are not indigenous to the continent but have become a major cash crop for Ghanaian farmers and an important source of income for traders to markets and hotels.

"A good crop can bring in money to buy fertilisers and farm equipment, and also help to pay for healthcare

and education for the family," he says. Recently, however, fields of stunted, yellowing, wilting cabbages, their leaves curled and dotted with mould, have become an all too familiar and devastating sight for the farmers of Ghana.

From his field station base in Kpong, Ghana, Fening works closely with smallholder farmers on pest control

strategies. Two years ago they started reporting that a new disease was attacking their crops. "It seemed to be associated with massive infestations of pink and green aphids," says Fening, "and from my studies of the way insects interact with many different vegetables, I'm familiar with the types of damage they can cause."

Farmers were typically seeing the total loss of their crops and he realised that the

devastation couldn't just be caused by sap-sucking insects. Despite no previous reports of viral diseases affecting cabbage crops in Ghana, the symptoms suggested a viral pathogen.

With funding through the CAPREX programme, Fening began work with Cambridge plant biologist Dr John Carr. The pair collected samples of cabbage plants in Ghana showing signs of

CABBAGES

disease, and also aphids on the diseased plants. Back in Cambridge, Fening used screening techniques including a type of DNA 'fingerprinting' to identify the aphid species, and sophisticated molecular biology methods to try to identify the offending virus.

"Aphids are a common carrier of plant-infecting viruses," explains Carr, whose research is funded by the Biotechnology and Biological Sciences Research Council as part of the £16 million SCPRID (Sustainable Crop Production Research for International Development) initiative. "The 'usual suspects' are turnip mosaic virus and cauliflower mosaic virus, which affect cabbages in Europe and the US."

"We found that two different species of aphids, pink and green, were generally

found on the diseased cabbages,” says Fening. “It turned out this was the first record of the green aphid species, *Lipaphis erysimi* (Kaltenbach), ever being seen in Ghana.” The pink aphid was identified as *Myzus persicae* (Sulzer).

What’s more, the virus was not what Carr expected, and work is now ongoing to identify the culprit. The sooner it can be characterised, the sooner sustainable crop protection strategies can be developed to prevent further spread of the disease not only in Ghana, but also in other countries in the region.

Another researcher who hopes that eradication strategies will be the outcome of her research project is Dr Theresa Manful. Like Fening, she is a researcher at the University of Ghana and a CAPREx fellow. She has been working with Cambridge

biochemist Professor Mark Carrington on African animal trypanosomiasis.

The trypanosome that causes the disease is carried by the tsetse fly, which colonises vast swathes of sub-Saharan Africa. “This is a major constraint to cattle rearing in Africa,” she explains. “Although trypanosomiasis is also a disease of humans, the number of cases is low, and the more serious concerns about the disease relate to the economic impact on agricultural production.”

Carrington has worked for a quarter of a century on the parasite that causes the disease. He understands how the organism evades the immune system of the animal by changing its coat proteins so as to remain ‘invisible’.

“When you first start working on these parasites you are enamoured with the molecular mechanisms, which we now know a huge amount about,” he says. “But then when you look at the effect on large animals like cows you realise that there is almost nothing known about the dynamics of an infection, and even whether an infection acquired at an early age persists for its lifetime.”

Manful and Carrington set about testing herds in Ghana. They discovered that several trypanosome species can be found in the cattle at one time and that nearly all cattle were infected most of the time.

For Manful, one of the important gains has been the ability to expand the research in Ghana: “I now have a fully functional lab and can do DNA extraction and analysis in Ghana – I don’t have to bring samples to Cambridge. We are teaching students from five Ghanaian institutions the diagnostic methods.” She and Carrington have been recently



Credit: Theresa Manful and Mark Carrington

funded through a Royal Society Leverhulme Trust Africa Award to continue their work.

“Agriculture faces increasing challenges,” adds Carr. “Bioscience is playing a crucial part in developing ways to mitigate pest impact and reduce the spread of parasites.

“We want to ensure not only that every harvest is successful, but also that it’s maximally successful.”

More than half of global population growth between now and 2050 is expected to occur in Africa. And more people means a requirement for more food



Words

Jacqueline Garget and Louise Walsh

ETHICOBOTS is funded under the Zoonoses and Emerging Livestock Systems (ZELS) programme, a research initiative in the UK jointly funded by six research council and government bodies.

Dr Ken Fening and Dr Theresa Manful were funded by the Cambridge-Africa Partnership for Research Excellence (CAPREx) and The ALBORADA Trust, through the Cambridge-Africa Programme.



Dr John Carr
Department of Plant Sciences
jpc1005@cam.ac.uk

Professor Mark Carrington
Department of Biochemistry
mc115@cam.ac.uk

Dr Ken Fening
University of Ghana
kfening@ug.edu.gh

Dr Theresa Manful
University of Ghana
tmanful@ug.edu.gh

Professor James Wood
Department of Veterinary Medicine
jlw2@cam.ac.uk

In Ghana, ‘Dumsor’ is a part of life. An annoyance, a risk, an impediment to be sure, but a part of life all the same.

The half-joking, half-serious term, which roughly translates to ‘off-and-on’, refers to the frequent blackouts in the country. Entire neighbourhoods go dark in an instant. The patchwork electrical grid can leave one side of a street in darkness and the other fully lit. So widespread are the blackouts that John Mahama, until recently the country’s President, was often referred to as ‘Mr Dumsor’ by Ghanaians.

Like many countries in sub-Saharan Africa, Ghana doesn’t produce enough power to meet demand. Its power supply has been erratic since the early 2000s, when water levels in the Akosombo Dam, the country’s main hydroelectric dam, dropped to dangerously low levels, and they have yet to recover fully. Although Ghana has one of the highest rates of access to electricity in Africa, in 2015 the country still experienced blackouts on 159 days.

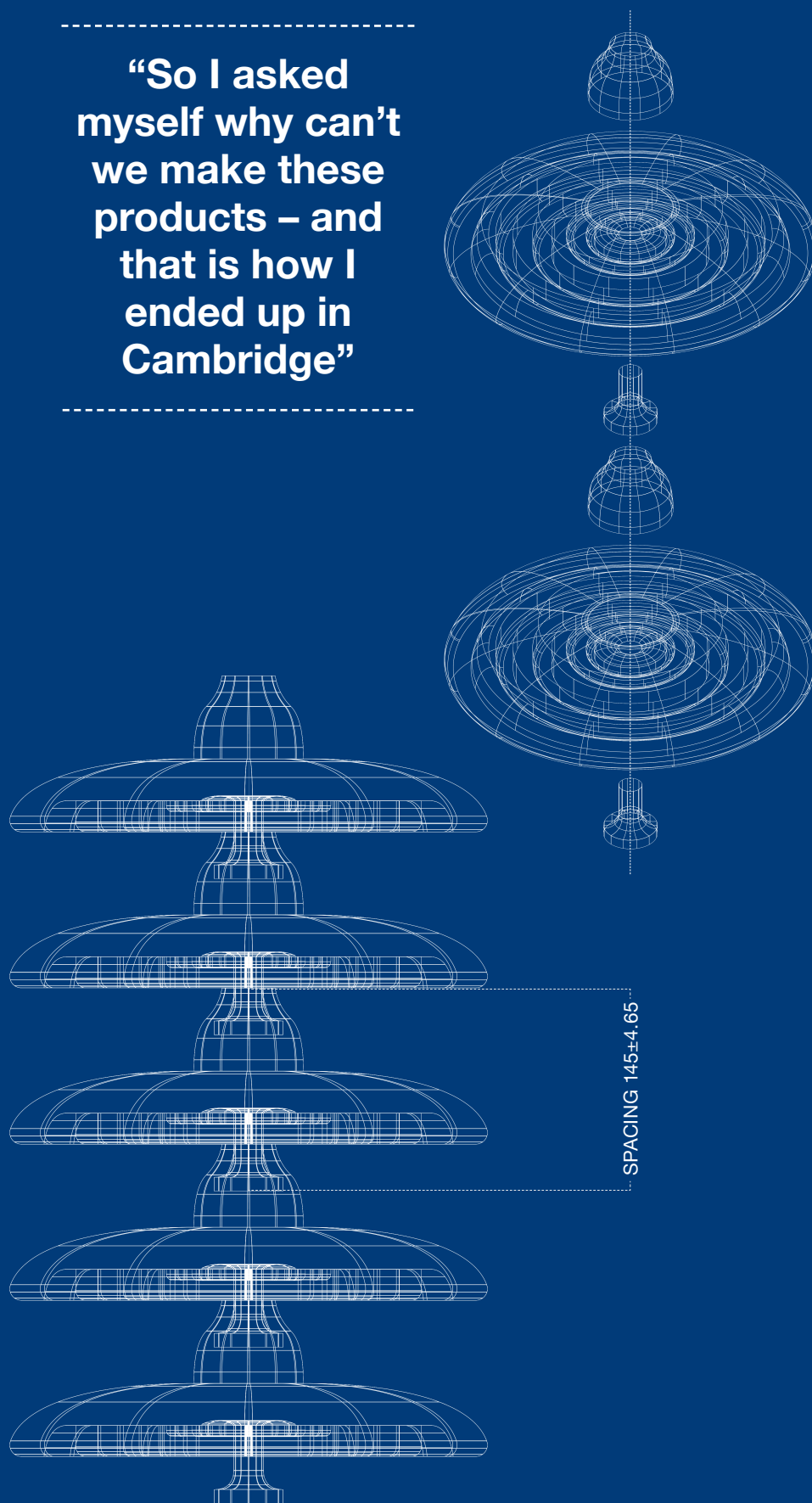
“Ghana’s not so different from the UK, really – both countries have an electrical grid that’s under enormous strain,” says Dr Kevin Knowles of Cambridge’s Department of Materials Science and Metallurgy. “The difference is we’d be up in arms if the lights went out all the time, whereas in Ghana it’s just a fact of life. But there are things that researchers in Ghana are doing to help improve the electrical infrastructure.”

One such researcher is Dr Abu Yaya, Head of the Department of Materials Science and Engineering at the University of Ghana. Yaya has been working with Knowles with the aim of developing a home-grown industry back in Ghana to make a small but crucial component for power transmission: electroporcelain.

For electricity to get from the places where it is generated, such as the Akosombo Dam, to homes and businesses, it needs a well-established electrical grid made up of pylons, substations and transmission lines. Whereas high-voltage power lines are insulated by the surrounding air, a physical insulator is required at the point where the power lines are supported by utility poles or transmission towers, or where power lines enter buildings. These insulators prevent the loss of current and concentrate its flow, as well as help prevent electric shock.

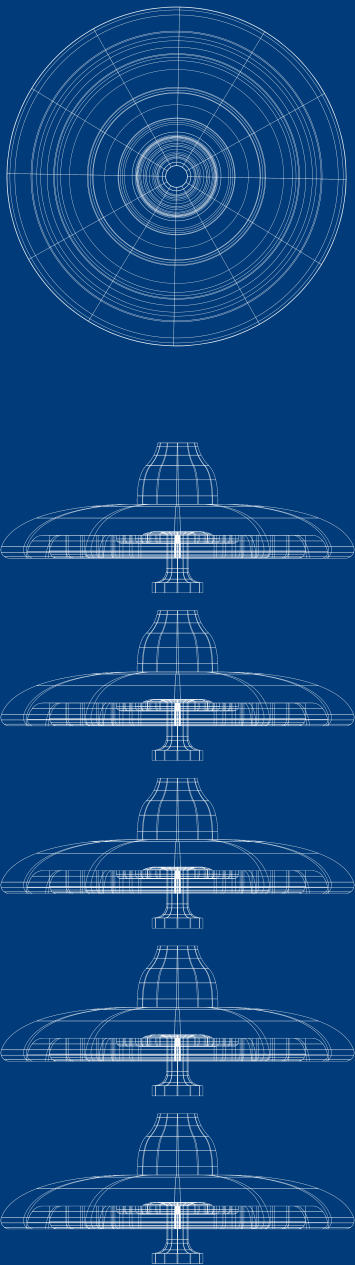
Most insulators for high-voltage power transmission are made from

“So I asked myself why can’t we make these products – and that is how I ended up in Cambridge”



Keeping the lights on in Ghana

Dumsor [dum so], noun, Ghanaian term to describe persistent electricity outages.



glass or porcelain. Knowles describes the electroporcelain manufacturing industry as “mature”. In fact, in the UK it’s been around since the 1860s – a reason perhaps why the insulators can look curiously old-fashioned and incongruous, like small white ceramic bowls or brown spiral candlesticks perched on the arms of pylons.

However, despite the prevalence of raw materials to make electroporcelain in Ghana, electroporcelain ceramics are imported from other countries at great expense.

It’s a frustrating situation says Yaya, who has now developed a method of making electrical insulators out of the materials available in Ghana. His aim is to scale up the process for commercial use in the country, and possibly to other sub-Saharan countries as well. The process is economical because all it needs is the raw materials, water and a furnace.

Yaya grew up in the slums in Nima, a suburb of Accra in Ghana. After completing his undergraduate studies in his home country, he received funding from the European Union to complete his Master’s degree in materials science at the University of Aveiro, Portugal, and the University of Aalborg, Denmark, and his PhD at the University of Nantes, France, after which he returned home to take up a post at the University of Ghana.

It was when he returned to Ghana that Yaya first became interested in developing electroporcelain, after a discussion with a retired lab technician who had a stockpile of clays and feldspar, but wasn’t sure what to do with it. “I figured out the clays and feldspar could be used to make electroporcelain, and at the same time I realised that Ghana imports all of its electroporcelain from Asian countries,” he says. “So I asked myself why can’t we make these products – and that is how I ended up in Cambridge.”

In 2015, Yaya won a six-month CAPREx fellowship at Cambridge to work with Knowles, an expert in materials for use in challenging engineering environments. Most of Knowles’ research focuses on how small changes to the microstructure of materials can improve their mechanical, electronic or optical properties for use in components such as connecting rods, fan blades, glass and fuel cells.

“In electroporcelain, the raw materials are clay, feldspar and silica,” explains Knowles. “When these raw materials are mixed together in the right proportions and fired together, at a temperature such as 1,200°C, an electrical insulator is produced. What happens during firing is that the feldspar melts and this helps to bind the particles together inducing further chemical reactions and reducing porosity. The result is a dense product that can be given a surface glaze to enable it to pass national safety standards tests for porcelain insulators.”

Yaya adds: “Normally, imported electroporcelains are made to suit the original country’s specifications, and are not made specifically for Ghana or other African countries, where the climatic

conditions could vary. By producing these products in Ghana using local raw materials, they are subjected to our own environmental conditions. They would be sent to the Ghana Standards Authority for further testing to ensure that failure does not occur rapidly when the electroporcelains are in use.”

As well as working closely with Knowles, Yaya has also spent time working with UK-based company Almath Crucibles to optimise his process. His aim from the outset was to develop a manufacturing process for electroporcelain that would meet international standards so it can be sold to Ghana’s electricity company.

It’s a crucial time for Ghana, which has committed itself to universal electricity access by 2020. Making sure the electricity supply is widely available and reliable will aid the growth of industries and the economic development of the country. It will also support the demand for power by an increasing population.

“If we are able to manufacture insulators in Ghana then they will be far more affordable than imported insulators, and we stand a better chance of expanding our electrical infrastructure to improve capacity,” explains Yaya. Meanwhile, foreign investors are beginning to take notice of Ghana’s richness in materials: in August 2016, a Chinese-owned company opened the first phase of a US\$60m factory in the Free Zone in Eshiem in Ghana to manufacture floor tiles and other ceramic products to supply domestic and international ceramics markets.

Yaya continues to collaborate with Knowles, as well as with other researchers in Europe. He is currently in the process of patenting his technique through a University of Ghana Technology Transfer Grant, and is now looking for potential commercial partners to help him bring the technology from a laboratory to an industrial scale.

“Dumsor is an irritation at times but it also shows the power crisis we must overcome,” he says. “We need to be sure that limitations in generating and distributing electricity do not become a development challenge for the country.”

Dr Abu Yaya was funded by the Cambridge-Africa Partnership for Research Excellence (CAPREx) and The ALBORADA Trust, through the Cambridge-Africa Programme.

 **Words**
Sarah Collins

 **Dr Kevin Knowles**
Department of Materials Science
and Metallurgy
kmk10@cam.ac.uk

Dr Abu Yaya
University of Ghana
ayaya@ug.edu.gh

Five years, five students: 25 Cambridge-Africa scholars

Words
Alex Buxton



Image
Taskeen Adam and Richmond Juvenile Ehwi, two of the Cambridge-Africa scholars

Taskeen Adam and Richmond Juvenile Ehwi are part of a PhD programme that's enrolling five African students per year for five years, to help train world-class researchers for Africa.

"Africa needs a million new PhD researchers over the next decade." It's a huge figure. Professor David Dunne uses it to explain the scale of need in Africa for a new generation of scholars who will pioneer sustainable solutions to many of the continent's challenges.

"There are world-class academics in Africa," he explains, "but not enough to train and mentor all the young researchers that Africa needs to

maintain and accelerate its progress. This is where Cambridge and other leading international universities can help, by making expertise and facilities available to help bridge this mentorship gap."

Dunne is Director of the Cambridge-Africa Programme, a University initiative that for the past eight years has been building collaborative links between Cambridge and Africa (see p. 20). The model is centred on Cambridge researchers helping to mentor young African researchers in their African universities and research Institutions. This contributes to research capacity building in Africa but also benefits Cambridge by widening the experience

and opportunities for its researchers and students.

However, that stark fact remains – a great many more new researchers are needed. With this in mind, a new Cambridge-Africa PhD studentship scheme began to enrol PhD students last year from all over Africa – five per year, every year for five years. "It's at least a beginning," says Dunne. "We want this programme to grow in Cambridge, and other universities."

One criterion is that the prospective student must be studying issues that are priorities for Africa. The research interests of the current students are broad: from urban growth to poverty, business associations to sustainable

industries, infectious disease to post-conflict citizenship.

Taskeen Adam is one of the PhD students. She'd worked as an electrical engineer for two years when she decided that she wanted to use her skills to bring about social change. "What attracted me to engineering was the challenge of solving technical problems. But my real passion is for humanitarian issues and the need to create quality education for all."

In 2012, the United Nations General Assembly declared access to the internet as a basic human right. But figures from 2014 gathered for Taskeen's home country of South Africa showed that more than 4,000 schools had no access to electricity and 77% of schools had no computers. Many thousands of children were missing out on the chance to learn the skills needed to make a better life.

Her research is enabling her to look at the educational opportunities afforded by the internet, in particular the potential of decolonised African MOOCs (Massive Online Open Courses) as a means for delivering inclusive educational programmes to the most marginalised learners in South Africa. She's keen to develop an online educational framework adapted for, and relevant to, communities in developing countries.

Taskeen completed her first degree at the University of Witwatersrand in Johannesburg. On graduating, and while working full time, she pioneered an initiative called 'Solar Powered Learning' to give students in rural areas access to technology that was both low cost and environmentally friendly.

The pilot project won Taskeen accolades. She was listed among South Africa's *Mail & Guardian's* top 200 Young South Africans for 2014. This gave her the confidence to embark on a career that would use her engineering skills in ways that could help to bridge inequalities.

As part of her Master's research, she spent two weeks in Kigali, capital of Rwanda, where she visited schools benefiting from a national scheme to equip every child with a laptop. It was clear that this commendable programme was failing to enhance learning. Although resources were being provided, there was a lack of focus on maintenance skills, curriculum integration and teacher professional development. In many cases, the children were more comfortable using the laptops than were their teachers.

"My trip demonstrated the mismatch between the deliverables and the outcomes of the scheme. The focus was on technology deployment, rather than on improving educational attainment," she says. "Many African governments seem to be following a similar path, and I hope

that, by using the resources, networks and expertise here in Cambridge, I might eventually be able to influence policy changes at the intersection of education and technology back in Africa."

Richmond Juvenile Ehwi also hopes to take his skills and expertise back to his home country, Ghana. He has just arrived in Cambridge to start his PhD in Cambridge's Department of Land Economy. After his first degree at Ghana's Kwame Nkrumah University of Science and Technology, he worked as a research consultant and estate manager.

Moving to Ghana's capital city, he became interested in the changes he saw in the property market. "Plush Western-designed detached houses, apartments and gated communities are springing up and I wondered what the future would be like for Ghana's urban landscape. While this development mirrors Accra's integration into the globalised city

"The world needs the unique knowledge and perspective that African researchers can provide"

concept, accompanying this trend are social, economic, environmental and cultural costs."

As Western lifestyles become increasingly popular, the older-style family compounds associated with traditional Ghanaian culture are declining, even in rural areas. "With literacy rates and standards of living rising, households are demanding greater privacy and better sanitation which, in most traditional compound houses, are greatly compromised," he explains.

In the West, gated communities are often seen in a negative light: they are associated with segregation, racial polarisation and social exclusion. While accepting the realities of this criticism, Richmond seeks to facilitate a balanced discussion and inspire evidence-based planning policies.

He suggests that, as new gated residences develop in the suburbs, there can be both material and social benefits for surrounding areas. "In Ghana, the new gated communities tend to be multiracial rather than segregated according to

race or nationality. The ability to pay for your house is what counts, not what you do or what your ethnicity is. Gated developments offer the security and services that most people aspire to," he says.

Entire neighbourhoods can benefit from the expectations of the owners of the new properties, he explains: "It's misleading to think of gated communities as isolated enclaves. People who live in them are not completely cut off from society. They travel to work, to malls and markets, to church services. These public spaces facilitate social interaction. Also, better-off households offer employment for gardeners, drivers and care givers – and help to raise incomes and opportunities."

His long-term plan is to create an Urban Study Research Centre back in Accra, and to take back a deeper understanding of the interplay of economic factors with social and cultural issues in urban development.

Dunne points to such plans as an indicator of the promise of the Cambridge-Africa PhD studentship scheme. "We are training 25 Cambridge-Africa scholars. It's a small number compared with the overall need. But these researchers are a starting point. They will train other researchers and the expertise will multiply back in Africa."

He adds: "It's not just that Africa needs research and researchers for its own use. The world needs African researchers. We can't have a situation where 14% of the world's population – living on a continent with unique culture, diversity and environment – contributes less than 1% of published research output. The world needs the unique knowledge and perspective that African researchers can provide to solve our shared global challenges."

The Cambridge-Africa PhD studentship scheme is funded by the University and the Cambridge Trust.

I **Taskeen Adam**
Centre of Development Studies,
Department of Politics and
International Studies
taskeendadam@gmail.com

Professor David Dunne
Director, Cambridge-Africa
Programme
dwd10@cam.ac.uk

Richmond Juvenile Ehwi
Department of Land Economy
rjuvenileehwi13@yahoo.co.uk

Extreme sleepover: Waste not, want not in Tanzania

Credit: Izhan Khan



Susannah Duck and Izhan Khan describe working with a Tanzanian community to install a sewage system that ‘digests’ and ‘cooks’ human waste into fuel and fertiliser.

We are surrounded by friendly and welcoming people, but the language barrier makes communication monumentally challenging. We feel far from the immaculate lawns and gleaming stone of King’s Parade on a summer’s day. Navigating through a cluster of buildings in sweltering heat, even the smell is new. It has a sort of rawness: uncooked meat, unrefined exhaust fumes, untreated sewage.

This isn’t a quick and isolated visit. Instead, it will be the first of many over the next two months to Vingunguti, a densely populated part of Dar Es Salaam, the largest city in Tanzania.

We are here as members of the student-led Cambridge Development Initiative (CDI), which runs several projects in the area. Ours focuses on engineering and, over the past three

years, we have been designing and piloting an innovative sewage system to bring cheap and safe sanitation to households that are beyond the reach of the urban infrastructure.

Today we’re helping to lay pipes at shallow depths and gradients to expand our sewage network to 11 new houses, one of the aims on this trip. We’re helped along by the enthusiasm of members of the community, who are keen to have latrines that are connected to a sewage system.

Pit latrines are common here. Not only are they dangerous to empty, and frequently overflow in monsoon season, but these holes in the ground also contribute to the high incidence of water-borne diseases.

But it’s not just about cleaner toilets and streets. CDI’s innovation is the conversion of simplified sewage into useful products – fuel and fertiliser – using a system that has no net waste. The sewage flows into a ‘digester’ (designed by a SOWtech, a Cambridge-based company) that generates methane gas, which can then be used by households

“On paper, this sounds great. But ensuring that it’s successful and sustainable in practice is tough”

as a safer and cleaner alternative to charcoal for cooking. The effluent output of the digester is then ‘cooked’ using a solar-powered dryer (the EvapoDryer) to make fertiliser for agricultural purposes.

Once the new households are added, CDI will have managed to connect over 400 people to good-quality sanitation infrastructure, moving 1.9 tonnes of waste away from houses every day and generating products for the community that are either used in the households or sold by local entrepreneurs to establish an additional source of income.

On paper, this sounds great. But ensuring that it’s successful and sustainable in practice is tough. There are several case studies – even within Vingunguti – that highlight the dangers of not adequately including the community in projects that directly affect them. With its ethos of participatory development, the CDI model focuses on community organisation, financial ownership and targeted skills and knowledge training. Mobilising the community is a critical first step in the process.

After a community has identified the need for improved sanitation, a Sanitation Users Association (SUA) is established, bringing all the households together and giving them responsibility for managing construction and maintenance. In fact, the householders themselves finance and help to build the network. They are loaned the capital for their latrine construction and they pay this back through a microfinance scheme delivered by a Tanzanian NGO founded and run by a CDI alumnus.

Equally important is the involvement of students from universities in Dar Es Salaam, who are part of a complementary organisation (CDI Tanzania). We work alongside each other every day on all aspects of the project, from designing the network to facilitating community meetings. The Tanzanian students offer a unique and valuable perspective on the sanitation issues facing these areas – their insights are crucial to the success of the project.

To be sure that the project has a sustainable impact, we organise educational sessions for community members, delivered by our Tanzanian partners. One focus is health awareness sessions for women and children, covering topics like hand washing and malaria prevention. According to a recent survey, 97% of households agree that the project has improved the health of the community.

One local participant, Mr Mbetela, believes that the dangers of cholera and malaria have now been eliminated as a result of the CDI project. Fatima, another resident, says it has brought peace between neighbours because of the better conditions of the street. Ms Zacharia tells us that the new system has removed the embarrassment she used to feel when using exposed pit latrines.

As we prepare to return to Cambridge, we hear that the municipal water authority is looking to adopt our team's sewage model, which could lead to 1,000 more people having access to safe, hygienic sanitation facilities in the coming years.

Meanwhile, CDI Cambridge and CDI Tanzania will carry on optimising the digester and cooker. Within 12 months, our goal is for there to be a fully functioning sanitation system, run and maintained by the community, removing human waste from households and turning it into essential products. The phrase 'waste not, want not' never seemed so apt.

Susannah is studying management at the Judge Business School, and Izhan has just graduated from the Department of Engineering.

www.cambridgedevelopment.org

I Susannah Duck
sd690@cam.ac.uk

Izhan Khan
izhankhan94@gmail.com

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**“We see girls’
education as
the starting point
to everything
– it generates a
multiplier effect
like no other”
p. 4**