



Unlocking agricultural prosperity in Africa



The BecA-ILRI Hub
Annual Report

2017



A scientist in a white lab coat and safety glasses is working in a laboratory. The scientist is wearing white gloves and is holding a small, dark object in their hands. The background is a laboratory setting with various pieces of equipment and a white wall. The entire image has a blue tint.


The BecA-ILRI Hub has continued to strengthen the capacity of African scientists to address key agricultural development challenges, including increased productivity, food safety and climate change adaptation and mitigation.

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biosciences
eastern and central africa





The Biosciences eastern and central Africa-International Livestock Research Institute (BecA-ILRI) Hub is a co-creation of the African Union's New Partnership for Africa's Development (AU/NEPAD) and the International Livestock Research Institute (ILRI).

The BecA-ILRI Hub's **vision** is to contribute towards improving the livelihoods of millions of resource-poor people in Africa using biosciences-based technologies that improve agricultural productivity, increase incomes and improve food and nutritional security.

The BecA-ILRI Hub's **mission** is mobilizing bioscience for Africa's development by providing a centre of excellence in agricultural biosciences, which enables research, capacity building and product incubation, conducted by scientists in Africa and for Africa, and empowers African institutions to harness innovations for regional impact.

In this issue, you will read about:

The new director talking about the role of BecA-ILRI Hub in African agricultural transformation and harnessing of joint interventions on issues affecting food security;

Building capacity to strengthen and accelerate production of research outputs by African researchers towards sustainable food and nutritional security and poverty reduction;

Our demand driven research that responds to high priority themes as indicated in Africa's Science Agenda for Agriculture in Africa through the Comprehensive Africa Agriculture Development Program;

Our diverse and dynamic technology platforms and research related services that support bioscience research by providing access to cutting-edge technologies, high level expertise and strategic leadership for advancement of research in agricultural development;

Progression of BecA-John Innes Centre (JIC) partnership to form Alliance for Accelerated Crop Improvement Africa (ACACIA) that has now enabled the engagement of a wider research community with multidisciplinary teams working together towards food security challenges;

Engagement with our advisory panel and a wide range of visitors coming to the Hub in the past year;

Details of our financial and human resources including new staff.

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| Fore



Jimmy Smith

Director general, ILRI



Jacob Mignouna

Director, BecA-ILRI Hub

The year 2017 was marked by new program leadership. BecA-ILRI Hub welcomed a series of new faces, among whom was the new program director, Jacob Mignouna, who brought with him a wealth of experience in leading research for development, with additional expertise in plant research. Our staff continue to show commendable commitment that is of great significance to the program.

We made considerable progress in supporting research in eastern and central Africa through our technology platforms that have continued to grow and serve a more diversified research community. This year served as the first full year of service for the Integrated Genotyping Service and Support (IGSS) platform and the integration of the new KASP genotyping technology. In some of the research led by the National Agricultural Research Systems (NARS), the application of new technology helped put into better understanding the genetic basis for resistance to the lethal necrosis disease that presents an increasing threat to farming in the region.

In 2017, we saw the alliance between BecA and John Innes Centre (JIC) grow into the Alliance for Accelerated Crop Improvement in Africa (ACACIA), which is now an interdisciplinary partnership to develop research and engagement on issues affecting food security in Africa.

word

The bioinformatics platform is under new stewardship which is pushing forward the adoption of new strategies towards its next phase of operations. We understand the role bioinformatics plays in research. For instance, the huge amounts of data generated by the platforms is of no value to scientists unless they are interpreted into meaningful information that highlight results. Following the recent recruitment of a bioinformatics scientist to head the platform, new strategies have been developed and adopted towards the next phase of operations.

In 2018, we continue to focus on the climate-smart Brachiaria project that has progressively expanded to west Africa, specifically Mali and Cameroon, where farmers have adopted the 'wonder grass'. One of the many findings of the project has confirmed that Brachiaria grasses host bacteria that support plant growth-promoting attributes, leading to high biomass production. We continue to conduct collaborative research with several advanced science institutions such as North Carolina State University (NCSSU), the bean project and the durable rice blast resistance project funded by Biotechnology and Biological Sciences Research Council (BBSRC).

The Africa Biosciences Challenge Fund (ABCF) fellowship program continues to enhance the capacity of national programs and to be a catalyst for agricultural biosciences innovation. The fellowship continues to support NARS led research and stimulate collaborations within the region and beyond.

The 'communities of practice' approach is already bearing fruit and the teams have begun to mobilize resources for joint research. The short-term training courses and clinics continue to provide great support to African researchers. This has enabled us to maintain our track record as the trainer of choice for biosciences in the region and beyond.

Global partnerships play a significant role in our activities because sustainability and impact are important to us. Our efforts at establishing new partnerships and reviving old ones have resulted in building more effective strategic relationships. In 2017, we saw the alliance between BecA and John Innes Centre (JIC) grow into the Alliance for Accelerated Crop Improvement in Africa (ACACIA), which is now an interdisciplinary partnership to develop research and engagement on issues affecting food security in Africa. The transformation of this alliance brought with it new partners with a wide range of expertise.

Edwin Onyiego, a greenhouse assistant at BecA-ILRI Hub is looking for signs of infestation on the experimental plants.

BecA-ILRI Hub is constantly reviewing its direction and priorities to revitalize the program. During the year, we were able to analyse and evaluate the 2013–2018 business plan in preparation for the next phase of operations. In 2018, we hope to have a new business plan that will propel us to the next chapter. To remain relevant in biosciences research, we took advantage of opportunities to engage with partners and stakeholders to hold key conversations that could lead to impactful synergies.

We thank all our staff for their commitment in helping the program achieve its mandate. We are also grateful to our partners and donors who believe in what we do and have confidence in our vision. As you read this annual report for 2017, which describes the highlights of our work in various stages of execution, we hope that our commitment to agricultural development in Africa and beyond makes itself evident.



A conversation with Jacob



In June 2017, ILRI welcomed Jacob Mignouna as the director for BecA-ILRI Hub. A trained plant molecular breeder and geneticist, Mignouna brings a wealth of experience in leading multilateral research.

Mignouna is a distinguished Frosty Hill research fellow. He has worked with the Institute for genomic diversity at the Cornell University. He was a research associate professor of biotechnology and co-director of USAID's Farmer-to-Farmer program at the Virginia State University. He served as the director for technical operations at the African Agricultural Technology Foundation (AATF), and most recently as a senior program officer and senior regional advisor for west Africa at the Bill & Melinda Gates Foundation in Seattle, USA.

In this conversation, he gives us insight into his understanding of the role of BecA-ILRI Hub in agricultural research in Africa, as well as the vision he has for the program.

How do you see BecA-ILRI Hub contributing to agricultural transformation in Africa?

BecA-ILRI Hub, with its mission of mobilizing bioscience for the transformation of African agriculture, is a center for excellence with world-class research facilities. It provides access to cutting-edge bioscience tools to scientists engaged in agricultural research across sub-Saharan Africa and beyond. To transform the agricultural sector, Africa will need new tools, products, processes and a conducive policy environment that fosters and encourages investments. If fully utilized, the knowledge, innovations and tools available through BecA-ILRI Hub, can certainly address some of the intractable challenges of African agriculture and contribute towards sustainable increases in agricultural productivity.

The strength of BecA-ILRI Hub appears to be on technologies. How do you ensure that technologies brought on board are relevant?

BecA-ILRI Hub's core areas of operation are technology platforms, capacity building and research. It is important to note that the Hub brings on board technologies for genomics, bioinformatics, molecular breeding, mycotoxin and nutrition analysis among others. We adopt new technologies based on the needs of the researchers in the region, as well as their relevance to agricultural biosciences.

For instance, the IGSS platform is supporting breeding programs from NARS, CGIAR institutions and the private sector. In the year 2017, we had 12 institutions using our services to support their breeding programs. Sixteen species were analysed through this service.

Our technology platform also supports NARS. A good example for this is the grant awarded by the US Defense Threat Reduction Agency to investigate the role of bushmeat in the transmission of six pathogens between animals and humans in

“*To transform the agricultural sector, Africa will need new tools, products, processes and a conducive policy environment that fosters and encourages investments.*”

Mignouna

Tanzania in the Bushmeat project led by Nelson Mandela African Institution of Science and Technology (NM-AIST). In many cases, the work fits into a bigger project and the components carried out by BecA-ILRI Hub are those that need sophisticated infrastructure and technical capacity, which many laboratories lack.

In 2017, BecA-ILRI Hub hosted 75 scientists from NARS. Working closely with national programs helps us understand their needs and together, formulate strategies that allow us to support them.

Moving forward, BecA-ILRI Hub will build on the successes of its operations and expand our research portfolio to embrace new innovations in crop and animal breeding, diagnostics and nutrition.

How does BecA-ILRI Hub contribute to food security?

Some of the current challenges affecting food security include climate change, diseases, inefficient or non-existent policies and infrastructures, low technical capacity and lack of access to markets. Using the tools and products generated from our research at BecA-ILRI Hub, technologies such as new varieties, techniques and diagnostics that can improve yields or eliminate disease can be distributed to and employed by farmers. Developing maize

varieties resistant to maize lethal necrosis disease (MLND) could be one example of what breakthroughs BecA-ILRI Hub can help introduce towards achieving food security.

What role is BecA-ILRI Hub playing in harnessing joint interventions on issues affecting agriculture in the continent?

BecA-ILRI Hub is strategically positioned to access a global network of African scientists and international experts while providing multiple linkages for cooperation across different disciplines and countries. This allows us to strengthen individual and institutional research capacities and address agricultural challenges in Africa. It allows linkages for collaboration in areas of research, technologies and capacity building. Through different partnerships, we have been able to bring on board and disseminate new technologies to NARS in the region. For instance, the JIC collaboration, now ACACIA, brought on board the golden gate and KASP technologies that have now been adopted and used by scientists from NARS and CGIAR centers.

Our state-of-the-art facilities and strategic collaborations allow us to provide comprehensive, competitive and specific bioscience services and support to drive solutions to Africa's food and nutrition challenges. Most importantly, partnerships give us

“Developing maize varieties resistant to MLND could be one example of what breakthroughs BecA-ILRI Hub can help introduce towards achieving food security”

a stronger voice which is critical in reaching policy makers beyond national or continental boundaries.

What is your vision for BecA-ILRI Hub in the next 5–10 years?

My vision is for BecA-ILRI Hub to accelerate its impact, expand its current technology platforms, and most importantly, re-engineer the ABCF program for capacity building.

Through BecA-ILRI Hub, I would like to raise the profile of bioscience research centers at the continental level and showcase the program's contributions to science and technology in the agricultural transformation agenda for Africa and beyond.

| Capacity



building

Emphasis on the role of science and technology has significantly increased in the recent years. However, there are still major issues deterring organizations from effectively implementing scientific and technological innovations including inadequate or weak skills, financial and infrastructural resources.

Following the recommendation of the Comprehensive Africa Agriculture Development Programme (CAADP) in 2014, African nations committed to devote at least 10% of their national budgets to agriculture, with the aim of getting a return of 6% annual growth in the sector. The Agricultural Science and Technology Indicators (ASTI) report compiled by the International Food Research Institute (IFPRI) indicate that although several countries are yet to achieve this target, great progress has been made. Ethiopia, Nigeria, South Africa and Kenya account for nearly half of the continent's spending on agriculture.

Nevertheless, spending on agricultural research remains low. It is important that investments are made towards building capacity for science, technology and innovation if issues affecting agriculture are to be effectively addressed. Investment on human capital is critical for agricultural research.

Patrick Bisimwa, a research fellow from the Evangelical University in Africa, DRC, conducting his research on the epidemiology and molecular characterization of African swine fever in DRC at Beca-ILRI Hub facilities.

Unlocking agricultural prosperity in Africa

Beca-ILRI Hub complements ongoing work in agricultural development in Africa through the ABCF program which is designed to enhance the capacity of researchers dedicated to solving agricultural problems in the continent. The program is focused on strengthening and accelerating the outputs of NARS towards sustainable food, nutritional security and poverty reduction. Through the program, Beca-ILRI Hub contributes to the narrowing of human and institutional capacity gaps. The program also catalyzes Africa's contribution to global scientific knowledge and innovation.

Beca-ILRI Hub offers a unique base for training and research opportunities using its high-end bioscience facilities and technologies including genomics, genetics and bioinformatics. The ABCF approach is all-inclusive. It delivers capacity building interventions through research, within organizational settings, cognizant of institutional and national capacity challenges.

Beca-ILRI Hub also supports NARS laboratories in mobilizing resources for equipment and technology upgrades to

ensure they have the right infrastructure to conduct research because we understand the level of skills, expertise and access to infrastructure and equipment in an organization determines its ability to generate and share innovative knowledge for research.

Hosting National Agricultural Research System researchers

The ABCF fellowships enable the hosting of NARS-led research which forms a major component of the capacity building program. Through the 6–12-month fellowships, 75 NARS researchers from 56 research organizations and 15 African countries had the opportunity to conduct part of their research projects at Beca-ILRI Hub.

The projects they bring must be approved and backed by their home institutions. In some circumstances, these projects feed into their postgraduate degree work. The fellowships create opportunities for our scientists and NARS researchers to explore prospects for expanding the scope of their projects and for co-developing new research ideas that further enrich the engagement between

CAPACITY BUILDING *...continued*

NARS and BecA-ILRI Hub.

Through the fellowship, NARS scientists can build relationships amongst themselves. Those with similar interests could build joint projects. If successful, it creates leverage of human and institutional resources across countries for combined actions. Fellows also learn how to develop pathways to impact which allow them to identify tools and products their research is expected to generate. Understanding the project impact pathway also enables them to come up with concise messages for stakeholders.

While hosted at the Hub, the research fellows are mentored by scientists from ILRI and other international research organizations who have diverse expertise and skills. In 2017, Tawanda Muzhingi and Mercy Kitavi of the International Potato Centre (CIP)

and Damaris Odeny of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) were key in providing support to many fellows.

In 2017, the ABCF fellowship program extended its reach by hosting a scientist from University of Abdou Moumouni in Niger. Moussa Hassan Ousseini spent six months at BecA-ILRI Hub conducting research on molecular characterization and phylogeny of local chicken populations in Niger. Moussa is part of a bigger cohort of scientists working on chicken genetics for health and wealth in western, central and eastern Africa.

The program maintained its engagement with the African Women in Research and Development (AWARD). Blessing Adanta, a lecturer at the University of Port Harcourt in Nigeria, and a graduate student at the University of Makerere in Uganda is one of last year's beneficiaries through this engagement. Her research at BecA-ILRI Hub focused on breeding for durable resistance to common bean rust in Uganda and was in part supported by AWARD. Adanta's research was able to develop competitive allele specific PCR markers associated with resistance to common bean rust.

These molecular markers are being used to develop bean seeds with resistance to the disease. Adanta graduated with a PhD from the University of Makerere, Uganda. This partnership supported three women scientists from Nigeria through the ABCF fellowship program in 2017.

A farmer proudly harvesting his seed potatoes.

Encouraging scientific publications

The number of scientific publications in Africa has significantly grown. However, Africa only accounts for 1% of the global research output. In 2017, NARS-led research conducted at BecA-ILRI Hub resulted in the publication of 21 scientific papers in peer-reviewed journals including *Frontiers in Pharmacology*, *Microbiology Open*, *Vaccine* and *Plos One*. A paper published on *Plos One* by Diaeldin Ahmed Salih Hassan from Animal Resources Research Corporation in Sudan and Wani Marcellino of the Ministry of Agriculture and Food Security in South Sudan, provided baseline survey on the prevalence and genetic diversity of *Theileria parva* in South Sudan. The findings of this research informed a new policy developed by the South Sudanese veterinary authorities currently being applied to control East Coast fever through the national vaccination program.

Mariette Anouma, a research fellow and a lecturer from the University of Dschang in Cameroon who conducted research at BecA-ILRI Hub two years ago on determining the genetic diversity of potatoes in Cameroon, published a scientific paper in the *American Journal of Potato Research* in 2017. The previously high yielding varieties of potato in Cameroon have seen a decline in productivity mainly due to pests, diseases and climate change. Her work consisted of developing new and improved varieties of potato germplasm towards building a core collection for conservation and crop improvement purposes.

A list of all the publications from the ABCF program on pages 47 at the end of this report.



Ten different viruses were detected including sweet potato badnavirus and sweet potato symptomless virus which have not been previously reported in the country.

Mentoring women to become future leaders in science

Growing up in Uganda, Joanne Adero's dream was to be a doctor. But she could not secure her dream of studying medicine so instead opted to embark on a course in biomedical laboratory technology at Makerere University. A module on microbiology was the beginning of her love for science and discovered her passion for research that eventually led her to research on sweet potatoes.

Adero is a research assistant at the National Crops Resources Research Institute (NaCRRI) in Uganda where she is part of the Genomic Tools for Sweet Potato Improvement Project team. Besides developing genomics and modern breeding tools, the project emphasizes capacity building and empowering research staff of national partners to carry out molecular work within their programs.

Due to its outstanding effort in capacity building, BecA-ILRI Hub offers a perfect base to do training in the use of modern, high-end bioscience technologies including

genomics, genetics and bioinformatics tools to facilitate crop improvement and improve genetic gains in sweet potato.

Adero secured an opportunity to conduct research at BecA-ILRI Hub through the ABCF program. She says that coming to BecA-ILRI Hub was one of her best career decisions because it gave her the opportunity to develop her capacity in molecular biology, genomics and bioinformatics.

While at BecA-ILRI Hub, Adero worked on molecular variability of sweet potato viruses to understand the nature of viral disease-causing organisms that are heavily affecting production of sweet potato in Uganda. The project enabled the determination of sweet potato viruses that exist in Uganda and their genetic diversity and distribution. Ten different viruses were detected including sweet potato badnavirus and sweet potato symptomless virus which have not been previously reported in the country. The work also helped generate the full genome sequence of the sweet potato feathery mottle virus, sweet potato virus c and sweet potato chlorotic fleck virus in Uganda.

The Genomic Tools for Sweet Potato Improvement Project is funded by the Bill & Melinda Gates Foundation (BMGF) and led by the North Carolina State University (NCSU) in partnership with the International Potato Center (CIP), the Boyce Thomson Institute at Cornell University, Michigan State University, the University of Queensland, the Uganda National Agricultural Research Organization, National Crops Resources Research Institute, the Ghana Council for Scientific and Industrial Research, Crops Research Institute (CRI) and BecA-ILRI Hub.

Joanne Adero (right) with a colleague collecting disease data at the sweet potato trial fields in NaCRRI, Uganda.



CAPACITY BUILDING *...continued*

Developing new varieties to boost Nigeria's cassava production

For Bunmi Olasanmi, a lecturer and a researcher at the University of Ibadan, Nigeria, the most exciting thing about science is developing improved varieties of crops for greater yields.

Olasanmi says he chose to work on cassava because it is a very important crop in Nigeria, which is the largest producer of the crop in the world mainly through subsistence farming.

The yellow cassava, a new variant of the root crop that is fortified with Vitamin A, is critical in helping meet nutrition requirements and improve human health. But biofortified varieties of cassava are susceptible to cassava mosaic disease (CMD). They also have poor plant architecture making them unsuitable for intercropping, which is important to small-scale farmers.

Selecting outstanding genotypes to develop CMD-resistant varieties of cassava using conventional screening methods alone may take about 10 years. Olasanmi used molecular markers to accelerate the process of developing the new varieties. Out of over 600 genotypes screened at BecA-ILRI Hub, he was able to identify 68 cassava genotypes with resistance to CMD and high beta carotene content. The clonal evaluation of cassava genotypes for desirable traits are ongoing and the field evaluations will be conducted at different locations in Nigeria for two seasons starting in 2019.

The University of Ibadan has a laboratory where Olasanmi could have done this work. However, it does not have adequate infrastructure to support all his research activities.

Olasanmi received his PhD in plant breeding from University of Ibadan. He was awarded a fellowship from the Institute for Genomic Diversity at Cornell University and was a finalist in the third Africa-wide young professionals in science competition that was run by the Young Professionals in Agricultural Research and Development.

Bunmi Olasanmi at the University of Ibadan's experimental fields harvesting cassava to evaluate the carotene content and plant architecture.

“The collaboration between BecA-ILRI Hub and NARS scientists and faculties promotes the advancement of skills that support research on issues affecting agricultural productivity in Africa. The establishment of branches of institutions such as BecA-ILRI Hub in other parts of Africa can enhance continental research applicable to food security.”

Bunmi Olasanmi, Lecturer, University of Ibadan, Nigeria



In 2017, the ABCF program adopted a new strategy towards ensuring that science/research is informing policymaking. We understand that influencing policy is one of the critical elements in creating an enabling environment for research outputs to translate into outcomes and eventually realize the intended impact. This fact was taken into consideration when the program decided to host three senior researchers from NARS.



Aissatou Diddi is the Head of Vaccine Production at the National Veterinary Laboratories (LANAVET). Her research was focused on epidemiology of Peste de Petits Ruminants (PPR) in Cameroon. LANAVET is Cameroon's national veterinary laboratory responsible for the surveillance, diagnostics and control of animal diseases. It also supports the national capacity building programs on areas of biological sample collection and transport and post-mortem examinations. The government of Cameroon has embarked on a mission to improve the supply of livestock services, access and delivery. Therefore, there is need to determine the nature and extent of genetic and antigenic variability and distribution in field populations for relevant pathogens like PPR and to assess the effectiveness of the available vaccines.



Lyna Tongo is the Director of Plant Clinic in the Democratic Republic of Congo (DRC), a project jointly initiated by the Faculty of Agronomy of the University of Kinshasa and the Université catholique de Louvain in Belgium. Her research was focused on detection and distribution of banana bunchy top virus in the DRC. Tongo and her team are responsible for operating a crop disease diagnosis platform that informs the government on crop disease pathogens of quarantine and supports them in developing specific policies for pest and disease management. They are also responsible for raising alerts on plant disease outbreaks.



Hassan Were is an associate professor in the department of biological sciences, chair of the postgraduate students and the team leader of the plant pathology research group at the Masinde Muliro University in Kenya. His research focused on the occurrence, distribution and molecular diversity of viruses in grain legumes in Kenya. Were specializes in areas of plant disease monitoring and surveillance, serological and molecular diagnosis of plant viral diseases and plant virus interaction studies for rice, potato, cassava and legume viruses. The training that Were received at BecA-ILRI Hub has enabled him to set up a diagnostics platform that will support research and training at his university.



Advancing skills through short courses

In 2017, BecA-ILRI Hub had a total of 11 tailored workshops and training courses in response to the needs of NARS in the region. The courses benefitted more than 375 African researchers. The courses are run with the train the trainer approach that ensures intense and focused hands-on experience with the trainees expected to pass the knowledge back to their peers in their respective institutions. In addition to the regular annual training courses, there were additional courses on proposal writing, effective scientific communication and data analysis. Some of the courses brought on board new partners such as the University of Liverpool that supported the data management workshop held in March. They provided financial support while the training was conducted by staff from BecA-ILRI Hub and the Earlham Institute, UK.

The introduction to molecular biology and bioinformatics workshop was held at the Rwanda Agricultural Board (RAB)

research station in Rubona, Rwanda. The laboratory at the research facility where the course took place was equipped by BecA-ILRI Hub through support from Swedish International Development Cooperation Agency (Sida). Several staff members of the RAB were trained on molecular biology and bioinformatics techniques to build their capacity towards using the upgraded facilities. The principles in laboratory management and equipment operations workshop was held at NaCRRI in Uganda, where more than 30 researchers and laboratory managers from over 10 African countries gained knowledge to help them ensure the operation of their research facilities are efficient and meet international laboratory management standards.

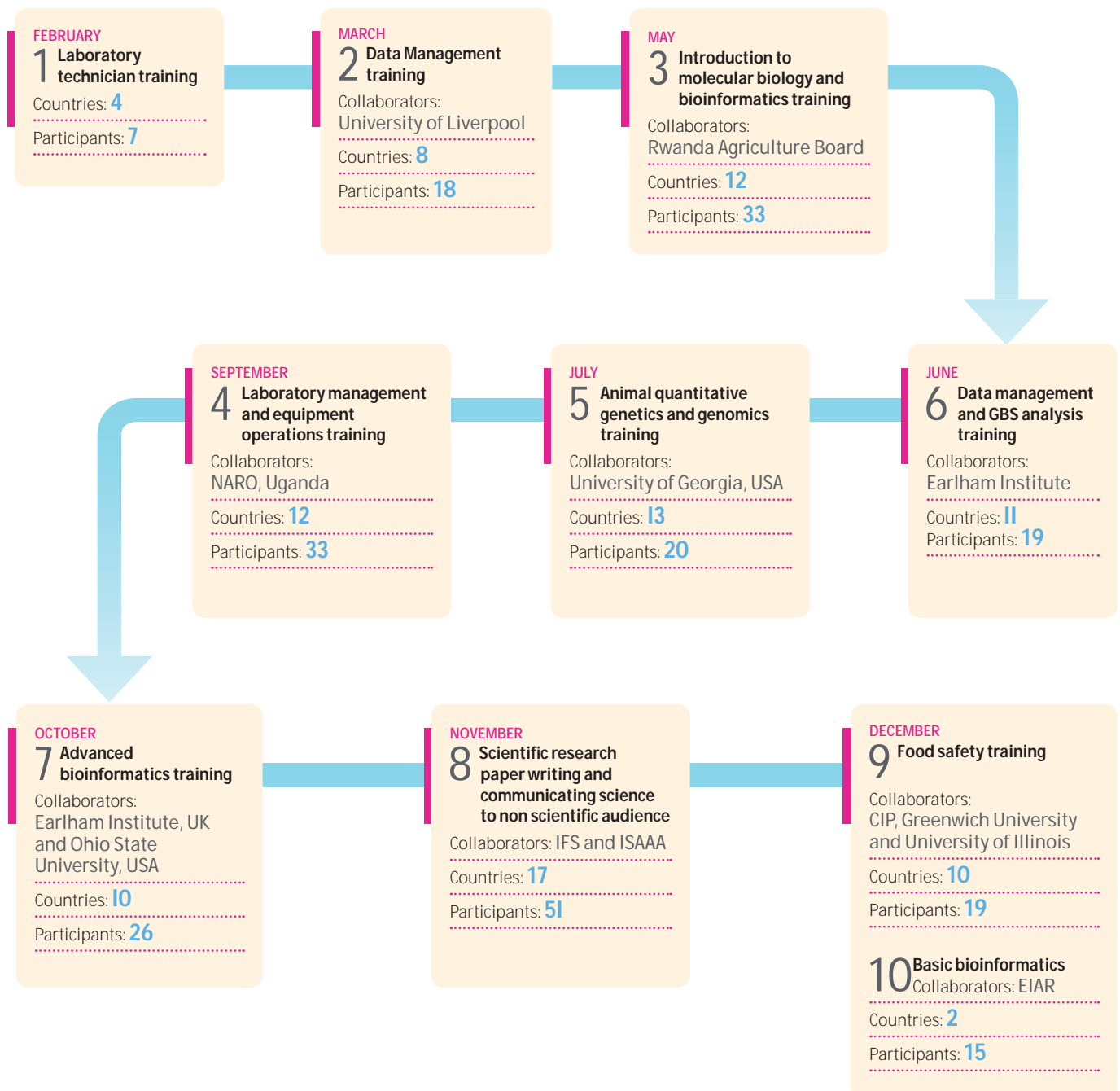
Our continued engagements with JIC brought on board other specialized forms of workshops. In January 2017, a four-day workshop on advanced cereals genetic research was held

Pilar Moreno (center) supporting research fellows during the advanced cereals genetic research training held at the BecA-ILRI Hub.

at BecA-ILRI Hub. The course was designed to introduce readily available genome sequence, marker and germplasm resources that can help accelerate research in cereals. The forum also provided room for consultations on matters affecting research on Triticeae especially for African cereal crops such as wheat, barley and teff. The following month, the plant metabolism for improved nutrition and health summer school was held at the NM-AIST in Arusha, Tanzania. The course was designed for postgraduate scientists with experience in plant nutrition. It introduced current methods used in plant metabolomics covering the breadth and depth of plant metabolism and how it can be exploited for the improvement of plant and human nutrition and health.

CAPACITY BUILDING *...continued*

Short courses in 2017



In 2017, Beca-ILRI Hub had a total of 11 tailored workshops and training courses in response to the needs of NARS in the region.

I CAPACITY BUILDING *...continued*

Writing winning proposals

Embracing its strategy towards collaborative research, BeCA-ILRI Hub conducted a proposal writing training for the members of the ABCF alumni-led communities of practice.

The training focused on understanding funding requirements, developing project structure, complying with the requirements of a call, understanding eligibility of activities including partners and budget, getting familiar with the project management cycle and submission procedures.

Using the peer review approach for proposal development allowed for critical analysis of issues and helped participants understand how to strengthen the basis of a proposal, develop content as well as present and defend pertinent arguments. At the beginning of the workshop, the teams were asked to bring ideas they wanted

to develop into proposals with a focus on the African Union Research Grant II 2017/18. By the end of the year, 10 draft proposals had been developed.

Understanding the dynamics of effective communication

Science communication is important in strengthening the interface between science and policy. However, it remains a challenge for most researchers, especially when they are expected to simplify their message for non-scientific audiences. The changing dynamics of science and the need to engage with multiple stakeholders makes it critical for scientists to acquire effective communication skills.

A training course on communicating science to non-scientific audiences was created to help fill this gap. More than 50 scientists convened with science communication experts to learn and practice in a course that combined hands-on creative activities,

small group discussions and mock interviews and press conferences. The topics covered included rules of effective communication; designing, packaging and communicating key messages; building trust with stakeholders and effective use of social media tools.

The training was conducted in collaboration with International Service for the Acquisition of Agri-biotech Applications (ISAAA) AfriCentre.

“*The only way we'll be able to fill the gap of misinterpretation and misinformation currently afflicting the scientific community is by communicating evidence-based facts*,” said Margaret Karembu, Director, ISAAA AfriCentre, on the opening of the training.

The scientists learned that non-scientific audiences are generally more interested in knowing the impact of research as opposed to the process of research. Often, people will remember a story more than theories, data and results. Telling a story about people whose lives have been directly affected by the issue being addressed through research is more likely to captivate an audience and possibly move them to action.

Left to right, Pius Mwambene (TALIRI, Tanzania), Wellington Ekaya (BeCA-ILRI Hub) and Ernest Baafi (Crops Research Institute, Ghana) are participating in a group activity during the proposal writing workshop held at BeCA-ILRI Hub.



In 2017, BecA-ILRI Hub hosted four students for the first time through the Professional Internships for PhD Students (PIPs).

Hosting PhD student interns

In 2017, BecA-ILRI Hub hosted four students for the first time through the Professional Internships for PhD Students (PIPs). The PIPs program is an initiative of BBSRC designed to develop transferable skills in students and raise their awareness of other career opportunities outside research. Pilar Moreno, Josie Maidment and Eleni Vikeli from University of East Anglia, and William Summers from the University of Cambridge spent three months each at BecA-ILRI Hub.

Pilar Moreno's research was on deciphering host responses to wheat yellow rust mainly by transcriptome analysis of infected wheat; Josie Maidment's research focused on determining protein interactions during rice blast disease infection; Eleni Vikeli's research was on the discovery of novel antimicrobials from the nests of Kenyan fungus-growing ants; and William Summers' research was on understanding the symbiotic interaction between rice and arbuscular mycorrhizal fungi. While at BecA-ILRI Hub, Summers also worked with the climate-smart Brachiaria grasses for improving livestock production in East Africa project.

All interns were involved in various activities including coordinating workshops and providing communications and training support.

Pilar Moreno organized a course on transcriptome data analysis that lasted three hours each week for the total duration of four weeks. The course had six research fellows from various African countries hosted at BecA-ILRI Hub through the ABCF program and working with a variety of livestock and crop species.

During this time, she supported them with data analysis using high-performance computing. She was also able to help them analyze genotyping by sequencing data and performing genome-wide association study (GWAS), as well as teaching them on the various ways of using R software to analyze data.



Eleni Vikeli provided support in streamlining communication activities. Her duties involved designing a module on science communication for diverse audiences to be incorporated in workshops, as well as conducting training for current research fellows on various aspects of science communication.

Vikeli believes this opportunity has helped her become more confident and more open to new ideas and activities. It also helped her build a stronger professional network and made her more aware of career options outside academia.



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<input type="checkbox"/>	Bacteriup_p_Firmicutes_n_Verrucomicrobiales
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<input type="checkbox"/>	Bacteriup_p_SPH1_n_SPH1
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<input type="checkbox"/>	Bacteriup_p_Firmicutes_n_Firmicutes

Our research is focused on breeding and genetics for crops and livestock, food safety and improved nutrition, livestock productivity, feeds and forages and climate change mitigation. To ensure success in our research, we continue to engage with various stakeholders including advanced research institutions, national agricultural research organizations, development partners and investors.



Goat

UNDERSTANDING THE REGION'S

Goats are critical to smallholder farmers because they are easier to acquire and maintain. In addition to providing great nutritional source through milk and meat, goats provide financial stability and they have lower feed and capital requirement compared to the larger livestock species. They also have shorter production intervals with higher prolificacy. Africa is home to about 35% of the world's goat population (FAO 2016)¹. They are distributed across all agroecological zones of Africa and show remarkable potential for adaptation and resilience to drought and major tropical diseases. However, production remains low due to several constraints including health, nutrition, breeding and management.

African indigenous goat breeds are unimproved and uncharacterized. The exotic breeds give immediate gains; however, the gains are impeded by poor resilience to climatic conditions, tropical diseases, pests and lack of sufficient quality feeds.

In 2017, Getinet Mekuriaw, an assistant professor at Bahir Dar University in Ethiopia came to BecA-ILRI Hub through the ABCF program. He conducted research to understand African goat genomics and uncover genetic diversity, genome-wide signatures of positive selection and linkage disequilibrium. He studied goat populations from Cameroon, Egypt, Ethiopia and Morocco and compared them with two breeds from Iran and China.



genetic diversity

The study confirmed high level of maternal genetic diversity in Ethiopian goat populations. Using populations from Gondar, Woyto and Guji areas of Ethiopia to determine the effect of Kisspeptin (KISS1) gene on litter sizes showed the increase in size when the gene is present. This means that this gene can be used for marker assisted selection in goat breeding programs. The genome-wide selection signature analysis revealed candidate genes related to adaptation to arid environment, reproduction, hair follicles development and trypanotolerance. The genetic potential of Arsi and Bale goats (alpine goats in Ethiopia found above 3500 masl) for hair fiber production was compared with Chinese cashmere goats. It was confirmed that genes linked to primary and secondary hair follicle development, melanin and epidermal growth were present in both breeds.

The project initially covered Cameroon and Ethiopia and the goat population data for both countries has now been made available. Markers which can be used for breeding have also been identified. The goat genetic diversity project has been extended to DRC, Rwanda, Tanzania, and Uganda to have a full picture of goat diversity in the region with the goal of using this information in selecting or developing breeds suitable for the various agroecologic zones in Africa.

The work has now been published in peer reviewed open access journals.

* Food and Agriculture Organization of the United Nations report on world statistical compendium for raw hides and skins, leather and leather footwear 1999-2015.

A photograph of a herd of goats in a dry, open landscape. The goats are of various colors, including white, black, and brown. They are scattered across the ground, some standing and some lying down. In the foreground, there is a large, fallen tree trunk that has been bleached white by the sun. The background shows a line of trees under a clear blue sky.

The goat genetic diversity project has been extended to DRC, Rwanda, Tanzania, and Uganda to have a full picture of goat diversity in the region with the goal of using this information in selecting or developing breeds suitable for the various agroecologic zones in Africa.

DISRUPTING SPREAD OF

| Viral diseases



Top left: Black bean aphid infestation on a bean plant. Besides transmitting viruses, severe aphid infestation causes damage to plants that makes them susceptible to other pathogens.

Bottom right: Aphids infesting common bean plants in Kenya. Aphids transmit among other viruses, BCMV and BCMNV.

Bottom left: Josiah Mutuku observing aphid infestation on common bean plants in a greenhouse at the BecA-ILRI Hub.

In bowls: Some of the common bean seeds often available in the markets in Kenya

In rural communities, the common bean is a great source of dietary proteins; vitamins such as folic acid and minerals such as iron, potassium, magnesium and zinc.

The common bean (*Phaseolus vulgaris*) is the most important legume crop in eastern, central and southern Africa. In rural communities, the common bean is a great source of dietary proteins; vitamins such as folic acid and minerals such as iron, potassium, magnesium and zinc. In addition, bean plants improve soil fertility due to their ability to fix nitrogen in soil.

Many farmers prefer to grow the common bean than other legumes because the crop has a short growing season and adapts to different cultivation systems. However, severe losses are common because of viral diseases.

Most common bean varieties preferred by farmers are susceptible to bean common mosaic virus (BCMV) and bean common mosaic necrosis virus (BCMNV). These viruses are transmitted by aphids and their occurrence is widespread in eastern and central Africa. Using metagenomics to conduct virus discovery in common bean, it was discovered that BCMV no longer appears to be widespread as previously reported. Instead the most prevalent type was found to be BCMNV. This is likely to be a result of the widespread adoption of bean varieties with genetic resistance to BCMV. However, when these BCMV-resistant varieties are infected by BCMNV, they induce severe reactions that result in death of the plant, which causes huge losses to farmers.



of common beans



When aphids settle on the beans to feed, they deposit the viruses leading to infection. With the aim of finding solutions to viral transmission in the common bean, controlled laboratory experiments were conducted to find out what attracts aphids to the crops. Results indicate that aphids are attracted to certain varieties of beans because of the 'odors' (volatile organic compounds) they release. In addition, it was discovered that viral infection changes the biochemistry of the infected plants so that their odors make the plant more attractive to aphids thereby encouraging more visitation.

Based on the above findings, a grant by the Global Challenges Research Fund (GCRF) is now supporting the University

of Cambridge and Beca-ILRI Hub to come up with solutions to eliminate the virus transmission. Currently, through a collaboration between Kenya Agriculture and Livestock Research Organization (KALRO) and RAB, an investigation into the potential of using common bean seed mixtures with different attractiveness to insect vectors as well as resistance to BCMV to disrupt vector transmitted viral disease is being done at Beca-ILRI Hub by Josiah Mutuku, a post doctoral scientist at Beca-ILRI Hub.

The characterization of the level of attractiveness on the bean varieties will provide the necessary information that will be passed on to farmers. For example, farmers could adopt the 'attractive plants', which may also be virus resistant, as decoys to attract aphids away from susceptible but farmer-preferred varieties. If successful, this approach will limit the spread of diseases, such as those caused by BCMV and BCMNV, without use of pesticides.

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| Africa's remarkable

Feed shortage is a major constraint in livestock production in sub-Saharan Africa. It is increasingly severe during the long dry seasons when green fodder is rarely available. Improved fodder production combined with appropriate conservation practices (silage and hay making) can play an important role in addressing animal feed shortages.


Beca-ILRI Hub's flagship climate-smart Brachiaria program has been collaborating and supporting NARS in carrying out research and capacity building on Brachiaria grass and tropical forages biosciences. The program also provides technical support in upscaling technologies to produce Brachiaria grass across sub-Saharan Africa. The Swedish International Development Cooperation Agency (Sida) has renewed its support for the project

for the next five years. In its second phase, the program will focus on the promotion of Brachiaria grass technologies, training of NARS scientists on forage biosciences, management of major Brachiaria diseases and identification of a Brachiaria seed production niche within sub-Saharan Africa.

Brachiaria grass has become the forage of choice among many farmers for its leafiness, high biomass yield, drought tolerance and significant increase in livestock productivity. Its ability to grow in low fertility soils, sequester atmospheric carbon dioxide and maximize the use of water and nutrients are other special features of this grass. Moreover, the grass is highly palatable and more nutritious to livestock than other tropical forages.

The program continues its upstream research on beneficial microbes that harness microbial capacity for drought tolerance, enhance water and nutrient uptake and promote disease management.

Microbial research has successfully documented the endophyte community of Brachiaria grass, identified their tentative roles in plant performance and established a collection of over 300 strains of partially characterized fungi and bacteria. Roles of these microbes include plant hormone production in soil phosphate solubilization, hydrogen cyanide production, iron utilization, control of plant pathogens and enhanced host biomass production. Almost half of the bacterial strains (41 of 84 strains) had a minimum of three plant beneficial properties. The ability of Brachiaria grasses to host genetically diverse microbes, many of them with multiple plant growth promoting attributes,



Brachiaria grass fields on ILRI campus, Nairobi.

forage grass

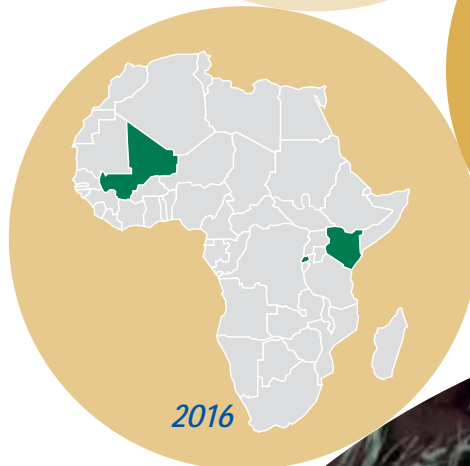
might have contributed to high biomass production, adaptation to drought and low fertility soils. The findings of this investigation have now been published in the *Journal of Microbiology*.

Following the planting and haymaking of *Brachiaria*, farmers have access to forage of up to three months within the dry season. Five *Brachiaria* varieties that are suitable for production in the east African region have been identified. Four of these varieties have been integrated into the mixed crop-livestock farming systems. Feeding lactating cows with *Brachiaria* grass was found to increase milk yield by 15–40% compared to feeding them other normally used local forage.

The climate-smart *Brachiaria* program has trained smallholder farmers in Kenya and Rwanda to grow the improved forage and provided seeds and planting materials to more than 6,000 farmers. With the support of the United States Agency for International Development (USAID)-funded Accelerated Value Chain Development (AVCD) program and other development organizations, this project reached about 22,000 households in Kenya and Mali where farmers were trained on hay production—an emerging agribusiness for youth and women.

The program has trained 20 African scientists on forage biosciences at BecA-ILRI Hub in Nairobi and supported two PhD and three MSc students since its inception. The program started with only two countries in 2013 and now reaches 12 countries in sub-Saharan Africa.

Priscila Ouma, a farmer from Busia County is preparing her dried Brachiaria for storage.



African countries benefitting from the Climate-smart Brachiaria program, 2013-2017.



Technology



Labomed, Inc.

platforms

BecA-ILRI Hub hosts diverse and dynamic technology platforms and research related services. Their purpose is to enhance bioscience research by providing scientists with access to a network of cutting-edge technologies operated with world class expertise and leadership principles. It is important that the platforms are equipped with diverse and up to date technologies that are relevant to the region's research needs.

The platforms support scientists from the CGIAR, NARS and the private sector by strengthening capabilities of researchers through training, development and validation of new tools for adoption. There are several platforms including genomics, bioinformatics, molecular breeding, mycotoxin, nutrition analysis and plant growth facility among others.

Using genome profiling to support upcoming plant breeders in East Africa

According to the United Nations, world population is expected to increase by around 2.4 billion people by the year 2050. Of this estimate, Africa alone will contribute to over half of the increase. Meeting the needs of the expanding population will require a drastic increase in food production.

Some of the challenges likely to be detrimental to the increase of food production are biotic and abiotic stresses; water scarcity; loss of agricultural land to urbanization; soil degradation and the adverse effects of climate change such as increased frequencies of stresses from heat, drought and pest and disease infestations. Improving food security will require development of highly nutritious as well as disease and pest resistant varieties that will withstand the impact of these changes.

The IGSS platform offers one of the most advanced genotyping facilities on the continent and is the only high-density genome profiling and breeding support service in Africa. The platform provides services to institutions in Kenya, Uganda, Tanzania, Rwanda, Ethiopia, Nigeria and Togo.



We have a track record of delivering high-quality data across a wide range of projects and species with a short turnaround time.

Mercy Chepngetich

*Research Associate,
IGSS Platform*

The KASP genotyping platform has been established to compliment the IGSS platform. While microsatellite (SSR) markers have delivered huge achievements, the characterization of genetic resources using SSR markers can consume a lot of time and resources. The KASP technology is simple, cost-effective and delivers faster analysis with high accuracy making it the ideal platform for modern breeding approaches and decision making for quick breeding.

Over 7000 samples from 12 institutions covering 16 species have been analyzed. Since its launch, the platform has supported three scientists from NARS, some of whose stories have been shared in this report.

The need for bioinformatics support is at its peak as scientists are increasingly using genomics applications in agricultural research. The bioinformatics platform at BecA-ILRI Hub provides advanced computational services, data storage, bioinformatics support and high-performance computing services to researchers.

TECHNOLOGY PLATFORMS *...continued*

Using KASP genotyping to develop disease resistant varieties of maize in South Sudan

Agriculture is the backbone of the economy of South Sudan. Maize is the most important cereal crop in Africa and in South Sudan it is ranked second after sorghum. Recently, maize lethal necrosis disease (MLND) has emerged as the deadliest maize disease in the region with devastating effects on maize yields.

MLND is a viral disease caused by a synergistic interaction of maize chlorotic mottle virus (MCMV) and the sugarcane mosaic virus (SCMV). So far, evidence indicates that these viruses can be carried through seed, especially when seed production fields have high incidence of MLND. Commercially adapted maize varieties grown in South Sudan are susceptible to MLND with yield loss as high as 100% in some cases. Breeding against MLND and availability of resistant maize varieties is the only viable option by which infections can be minimized.

Luka Awata is a senior research scientist and head of the

maize breeding program at the Ministry of Agriculture and Food Security in South Sudan. He is also a PhD student at the University of Ghana under the West Africa Centre for Crop Improvement. His major research interest is breeding for improved maize varieties.

Using modern molecular tools available at BecA-ILRI Hub enabled Awata to select 46 markers of maize breeding lines out of a total of 3200 within a period of six months. This work would otherwise have taken between 8–10 years to complete. With support from the International Maize and Wheat Improvement Centre (CIMMYT) and Kenya Agriculture and Livestock Research Organization (KALRO), the phenotypic selection to confirm the resistant varieties has now started in Kenya. However, there are no plans to do field trials in South Sudan due to financial constraints and the phenotypic selection is being done under the assumption that the varieties suitable for Kenya will be adopted in Sudan.

Awata was able to use the recently established KASP genotyping platform at BecA-ILRI Hub where he has learnt to use molecular breeding, genomics and bioinformatics tools which have increased his confidence and enabled him to use his full potential as a scientist.

Using modern molecular tools available at BecA-ILRI Hub enabled Awata to select 46 markers of maize breeding lines out of a total of 3200 within a period of six months.

Luka Awata is evaluating his maize crop at the CIMMYT field trial center in Naivasha.



With only a few years of science research under his belt, Obua has made remarkable strides in his study on the development of new soybean varieties.

Supporting soybean breeding

When you listen to Tonny Obua talk you begin to understand almost immediately that he is a man passionate about science and agriculture. Obua is a breeder and assistant lecturer at Makerere University's department of agricultural production. His research focuses on genetics, seed systems and the development of new soybean varieties.

Soybean is an important crop in Uganda and across Africa but its production is being impeded by environmental challenges such as erratic rainfall, declining soil fertility, pests and diseases and loss of genetic diversity. New varieties that can withstand the above challenges are becoming increasingly necessary. The general objective of Obua's project at BecA-ILRI Hub was to

determine the genetic diversity of Ugandan soybean germplasm, variability of different nutritional traits (total oil, total protein and fatty acids), and determine the GxE interaction for oil content and oleic fatty acid in soybean. The development of soybean varieties that have high quality oil is expected to increase their value in the world market and give better returns for African farmers.

With only a few years of science research under his belt, Obua has made remarkable strides in his study on the development of new soybean varieties. Results of Obua's study confirmed the presence of low levels of diversity within most of the genotypes studied. This is a matter of concern because the low diversity in the germplasm pool makes the crops more vulnerable to effects of pests,

diseases and climatic change. The variation of production is also limited across the varieties.

In his view, one of the most exciting experiences was the opportunity to come to BecA-ILRI Hub to conduct research through the ABCF program. This program gave him access to the IGSS platform that enabled quick processing of genetic data more accurately and affordably. During his time at BecA-ILRI Hub, he gained skills in genotyping by sequencing, genomics, data management and analysis and using various other bioinformatics tools.

Tonny Obua (left) and two project collaborators from Tanzania are checking the nodulation of different soybean genotypes at a field trial site in Ngetta, northern Uganda.



TECHNOLOGY PLATFORMS *...continued*

Advancing bioinformatics tools to generate research outputs for agricultural advancement

The need for bioinformatics support is at its peak as scientists are increasingly using genomics applications in agricultural research. The bioinformatics platform at BecA-ILRI Hub provides advanced computational services, data storage, bioinformatics support and high-performance computing services to researchers.

In late 2017, Jean-Baka Domelevo Entfellner joined BecA-ILRI Hub as the scientist in charge of the bioinformatics platform. He holds a PhD in bioinformatics from the Montpellier Laboratory of Informatics, Robotics and Microelectronics (LIRMM), a National Center for Scientific Research (CNRS) laboratory in France.

Through a short interview, he talks about how the platform is advancing bioinformatics research in the continent.

What is the role of the bioinformatics platform?

The bioinformatics platform at BecA-ILRI Hub is designed to support research and training. With a core team of scientists combining a broad set of skills, the platform provides a hub for bioinformatics activities. It handles tens of thousands of transactions of molecular data and statistical

analyses every year and has generated hundreds of terabytes of data. The platform supports collaborative research with high quality outcomes and hands-on training to develop the skills of researchers in the region.

What are your key responsibilities at BecA-ILRI Hub?

The range of activities currently implemented or will be implemented in the future can be categorised into three. One category falls under 'traditional' capacity building activities involving a fair amount of time and energy spent by the bioinformatics team and aiming at the best results in terms of sustainable capacity development at organizational and regional levels. The second category is characterised by pure service provision activities based on a consultancy paradigm, aiming at the rapid delivery of quality omics data analysis with little to no capacity transfer. Most activities fall here with much room for new activities to implement on the side of the service provision end. The third one is to provide support for research activities.

How does this platform plan to embrace technological advances in bioinformatics?

We could take pride in bringing on board the best technologies and



At BecA-ILRI Hub, we have adopted a long-term training model where we will host a cohort of scientists for a period of eight months to one year and build them to become competent bioinformaticians.

Jean-Baka Domelevo Entfellner

Bioinformatician

cutting-edge science for accurate data analyses. But I think we should work on it constantly, harnessing the latest technological and algorithmic developments and making it our duty to be the first group on the continent to showcase such development in the context of agricultural biosciences. For instance, when it comes to designing an analysis pipeline especially tailored to the genetics of crops or livestock, or participating in the elaboration of tweaked sequencing platforms (e.g. with modified, cheaper or lower-throughput chemistry) by tackling the specific challenges arising in the

| Engagements



Left to right, BecA-ILRI Hub collaborator Stephen Runo briefing JIC partners Rebecca Corkill, Oluwaseyi Shorinola and Sam Munford on his research on Striga at Kenyatta University labs in Nairobi.

and partnerships

Partnerships play a critical role in helping us achieve our mandate. Maintaining our existing partners while building new ones with the aim of establishing and implementing impactful research is key.

A growing partnership

Jacob Mignouna and Dale Sanders at the ACACIA launch at the John Innes Centre, UK.

Following an agreement signed in 2014, the collaboration between BecA-ILRI Hub and JIC has been playing a key role in capacity building, technology transfer and resource mobilization for agricultural research for development in Africa.

The immense growth of the partnership led to the formation of ACACIA, which was launched in June 2017. Building on the previous alliance, ACACIA will facilitate the engagement of a wider research community with multidisciplinary teams to develop research and biotechnology approaches and improved food and nutrition security.

The strategic positioning of BecA-ILRI Hub will enable access to research facilities to NARS scientists who are responsible for delivering science that can register desired impact.

In the past year, ACACIA has been able to support various capacity building activities and collaborative relationships between teams of scientific and technical experts from both organizations.

One of the key mandates of the alliance is to give African crop researchers and institutes access to technologies necessary for acceleration of crop improvement in Africa. In this regard, JIC sponsored a postdoctoral scientist, Oluwaseyi Shorinola, for a four-



ENGAGEMENTS AND PARTNERSHIPS *...continued*

month stay at BecA-ILRI Hub where he was involved in the establishment of the KASP genotyping platform, which will support and accelerate crop breeding in sub Saharan Africa. Staff who will manage the platform at BecA-ILRI Hub have been fully trained on the new technology and are already transferring the new skills to NARS scientists.

The chart shows highlights of ACACIA related activities in 2017.

MARCH

BBSRC/SASSA scoping workshop at BecA-ILRI Hub

Leah Kago, a research associate, is at JIC on training on GoldenGate technology, plant transformation and microscopy (both bright field and fluorescence)



JANUARY

Molecular breeding workshop at BecA-ILRI Hub

Tilly Eldrige, a post doctoral scientist from JIC is at BecA-ILRI Hub to support the capacity building program through project reviews and to supervise ABCF research fellows



FEBRUARY

AfriPlantSci metabolism for improved nutrition & health workshop at NM-AIST Tanzania

JUNE

Formal launch of ACACIA at JIC

Joyce Njuguna, a bioinformatician at BECA-ILRI Hub, visits JIC on a mission to explore new opportunities for strengthening the bioinformatics platform

Frederick Nganga, a research associate at BecA-ILRI Hub, visits JIC to understand how JIC manages its mass spectrometry and metabolite profiling platform as a service unit

Plant-insect interactions symposium held at BecA-ILRI Hub



APRIL

Arrival of **Josie Maidment**, Pilar Corredo Moreno and Eleni Vikeli at BecA-ILRI Hub



SEPTEMBER

Oluwaseyi Shorinola, a post doctoral scientist at JIC, comes to BecA-ILRI hub to support the establishment of the KASP genotyping platform and to train staff on its use



JULY

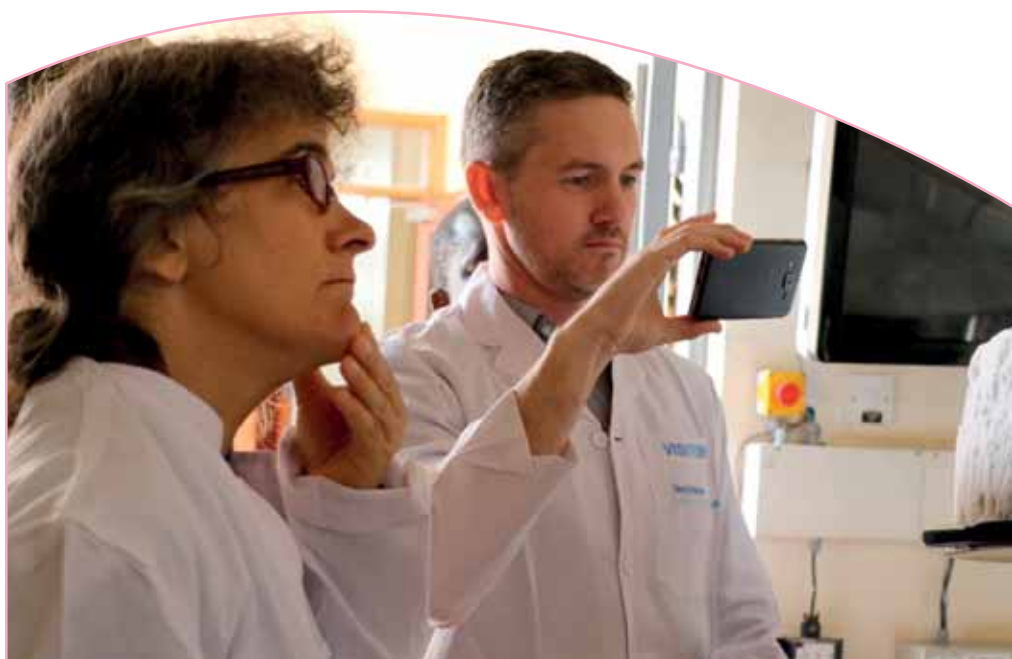
Francesca Stomeo, a scientist at the BecA-ILRI Hub, spends a week at JIC exploring new opportunities for strengthening the genomics and bioinformatics pipeline through management tools



(Right) Getinet Mekuriaw, a research fellow from Bahir Dar University in Ethiopia talks to the Sida Research Council committee members about the goat genetics community of practice (CoP).



ILRI is a beneficiary of Sweden's support to agricultural research for development in Africa including support to BecA-ILRI Hub's capacity strengthening activities.



Visitors

BecA-ILRI Hub continues to be of interest to several high-profile organizations and delegations. The visits give the Hub an opportunity to highlight its role as a strategic partner in agricultural research for development in the region. In 2017, BecA-ILRI Hub hosted several visitors from various institutions and donor agencies. Below, we share details on some of the visitors.

Swedish International Development Cooperation Agency (Sida) research council

A delegation from the Sida research council visited BecA-ILRI Hub laboratories in Nairobi in January 2017. The delegation was led by the council chair, Thomas Roswall, vice chancellor of Swedish University of Agricultural Sciences and director of International Foundation for Science. During the visit, the delegation met with researchers from across Africa, as well as ILRI's senior management.

ILRI is a beneficiary of Sweden's support to agricultural research for development in Africa including support to BecA-ILRI Hub's capacity strengthening activities.

Ugandan Minister of Science, Technology and Innovation

Elioda Tumwesigye, the Ugandan minister for science, technology and innovation, visited BecA-ILRI Hub in March 2017. Tumwesigye, who was at the ILRI Nairobi campus for a meeting at the AATF, had an opportunity to meet ABCF research fellows from Uganda. Accompanying the minister were AATF executive director Denis Kyetere, executive director of Uganda National Council for Science and Technology, Peter Ndemere and AATF's project manager for the Open Forum on Agricultural Biotechnology (OFAB) in Africa, Daniel Otunge.

Australian Centre for International Agricultural Research

In June 2017, Andrew Campbell, chief executive officer of the Australian Centre for International Agricultural Research (ACIAR) visited BecA-ILRI Hub. He was accompanied by Mellissa Wood, ACIAR's general manager for global programs. One of the highlights of the tour were discussions with scientists from NARS who were conducting their research at BecA-ILRI Hub under the ABCF program.

Marianne Bänziger, deputy director general for the International Maize and Wheat Improvement Center (CIMMYT) and Michael Quinn, head of the Excellence in Breeding Platform visit the BecA-ILRI Hub.

Head of the CGIAR excellence in breeding platform

In August 2017, Michael Quinn, head of the new CGIAR excellence in breeding platform*, and Mariane Bänziger, deputy director general for CIMMYT, visited BecA-ILRI Hub. They toured the various technology platforms including genomics and bioinformatics, IGSS and plant molecular breeding. They also visited ILRI's biorepository unit and interacted with staff from CIP, the International Institute of Tropical Agriculture (IITA) and NARS researchers hosted at ILRI. Quinn and Bänziger were on a mission to assess the status and challenges of breeding programs of individual centres, which underpin the agenda of the new platform.

*The CGIAR excellence in breeding platform supports modernization of breeding programs in developing countries for greater impact on development, food and nutrition security and climate change adaptation. The platform provides access to cutting-edge tools, services and best practices, application-oriented training and practical advice.



Left to right, Miriam Otipa (KALRO), Miriam Kinyua (University of Eldoret), Samuel Mutiga (BecA-ILRI Hub), Lusike Wasilwa (KALRO) and Jim Corell (University of Arkansas) examine rice in irrigation fields in Tanzania-Durable Rice Blast Resistance for Africa project.



The 2017 Advisory Panel meeting held at ILRI, Nairobi.

Front left to right: Sita Ghimire, Sir Ed Southern, Josephine Birungi, Margaret Munene, Jacob Mignouna, Theresa Sengooba, Eugene Terry, Irene Annor-Frempong.

Back left to right: Dieter Schillinger, Rachael Mwangi, Roger Pelle, Andy Watt, Jimmy Smith, Abdou Tenkouano, Diran Makinde, Ed Rege, David Barasa and Wellington Ekaya.

Advisory panel

BecA-ILRI Hub's advisory panel provides strategic advice to ILRI's senior management, board of trustees and the New Partnership for Africa's Development (NEPAD). The panel consists of leaders and experts in biosciences, key stakeholder organizations, policy experts and private sector, who provide additional ground for the program's research approach.

NEPAD plays a key role in providing strategic direction on approaches to the broader spectrum of bioscience research including livestock and crop research to ensure alignment with African priorities in food and agriculture, science and technology and capacity development.

The advisory panel meeting was held in October 2017. A key message from the meeting was the need for BecA-ILRI Hub to do more awareness creation work using its competitive advantage in offering unmatched research, facilities and capacity building for agricultural development in Africa.

Here are the members who attended the 2017 advisory panel meeting held in Nairobi.

Eugene Terry (Chair) Senior technical adviser, New Markets Lab, USA

Theresa Sengooba Senior advisor, Project for Biosafety Systems, IFPRI

Sir Ed Southern Founder, Kirkhouse Trust, UK

Abdou Tenkouano Executive director, West and Central African Council for Agricultural Research and Development, Senegal

Diran Makinde Senior advisor to CEO, African Union-NEPAD, South Africa*

Irene Annor-Frempong Director for research and innovation, Forum for Agricultural Research in Africa, Ghana**

Ed Rege Director, PICO Eastern Africa, Kenya

Margaret Munene General manager, Palmhouse Dairies Ltd, Kenya

Andy Watt Managing director, QualiBasic Seed Company, Kenya

Dieter Schillinger Assistant director general, ILRI, Kenya

Jacob Mignouna Director, BecA-ILRI Hub, Kenya

*Representing Aggrey Ambali, Advisor and Head of NEPAD Science, Technology and Innovation Hub

**Representing Yemi Akinbami, Executive director of Forum for Agricultural Research in Africa.

BecA-ILRI Hub continues to deliver its mandate by ensuring that it has subject matter experts on its portfolio who can lead its core operational components. This way, it can support the region in building capacity and adopting new technologies applicable to research.

New appointments



Christian Tiambo is a postdoctoral scientist at BecA-ILRI Hub. His main role is to provide technical and implementation support in livestock genetics research using advanced genomics and bioinformatics tools. Prior to joining BecA-ILRI Hub, Tiambo was a senior lecturer and coordinator of the animal science program at the University of Buea in Cameroon. He holds a PhD in animal breeding and genetics improvement with focus on local chicken development from the University of Dschang, Cameroon.



Dorothy Onyango is a research associate in the ABCF program where she is responsible for providing high level and comprehensive technical support to scientists and research fellows in the areas of stock management and requisition of reagents, supplies and equipment. Onyango is a plant geneticist/breeder and previously worked with International Rice Research Institute (IRRI) and CIP.



Elijah Mwaura is the program accountant at BecA-ILRI Hub. He holds a degree in commerce with a specialization in finance and is a member of the Institute of Certified Public Accountants of Kenya (ICPAK). Mwaura is responsible for ensuring effective use of grants in line with donor agreements.



Jackline Chepkoech is a research associate in the IGSS platform. She is responsible for operations including the organization and coordination of all platform activities. She holds a degree in biomedical technology from the University of Nairobi.

Staff

in 2017

Jacob Mignouna joined BecA-ILRI Hub in June 2017 as the director. He is responsible for growth through advancement and expansion of research, technologies, donor portfolio and new partnerships at BecA-ILRI Hub. Mignouna also provides strategic guidance in steering the program into the next phase of operations. Prior to joining BecA-ILRI Hub, he worked with the Bill & Melinda Gates Foundation as senior program officer in agricultural development.



Peter Emmrich is a postdoctoral scientist working on the improvement of the grass pea for food and feed. Before joining BecA-ILRI Hub, Emmrich was a postdoctoral scientist at JIC in the UK. He plans to translate his previous research by screening new low toxin material in Kenya and investigating the potential for intercropping grass pea with forage grasses, particularly *Brachiaria*, to improve the drought tolerance of forage systems and the nutritional value of forages in Africa.



Jean-Baka Domelevo Entfellner is a scientist leading the bioinformatics platform. He is responsible for providing expertise in computational analysis of omics data as well as designing and implementing capacity building activities in bioinformatics. Before joining BecA-ILRI Hub, Entfellner was a senior lecturer in computer science at the University of Western Cape, South Africa and a postdoctoral fellow with the South African National Bioinformatics Institute (SANBI).



Mercy Chepngetich is a research associate in the IGSS platform. She is mainly responsible for technical support in statistical data analysis and interpretation, maintenance of data quality control, management of workplans and development of laboratory protocols. Before joining BecA-ILRI Hub, Chepngetich worked as a lecturer at the Jomo Kenyatta University of Agriculture and Technology in the department of statistics and actuarial science.



Moses Nderitu is a research associate in the IGSS platform. He is responsible for maintaining the IT infrastructure including the installation, maintenance and development of KDDart knowledge discovery system and the development and adoption of new algorithms for various aspects of IGSS operations. He also provides support towards downstream bioinformatics.



Staff in 2017 *...continued*

SCIENTISTS

Appolinaire Djikeng, Director*

Jacob Mignouna, Director

Josephine Birungi, Deputy director and technology manager

Clay Sneller, Lead plant breeder

Francesca Stomeo, Scientist, capacity building*

Jean-Baka Domelevo Entfellner, Bioinformatics

Nasser Yao, Plant molecular breeder

Roger Pelle, Molecular parasitologist

Sita Ghimire, Plant pathologist

Wellington Ekaya, Senior Scientist, capacity building

POSTDOCTORAL SCIENTISTS

Christian Tiambo, Livestock geneticist

Josiah Mutuku, Plant pathologist

Peter Emmrich, Metabolic biologist

VISITING SCIENTISTS

Adriana van der Does, Plant pathologist

Samuel Mutiga, Plant pathologist

Tilly Eldridge, Plant geneticist

Oluwasheyi Shorinola, Plant geneticist

RESEARCH ASSOCIATES

Ben Kiawa, Unit coordinator, SegoliP

Boniface Muganda, IGSS platform

Collins Mutai, Brachiaria project

Dedan Githae, Bioinformatics

Denis Mwangi, IGSS platform

Dorothy Onyango, Capacity building

Eunice Machuka, Capacity building

Frederick Ng'ang'a, Mycotoxin and nutritional analysis platform

Jackline Chepkoech, IGSS platform

Joyce Nzioki, Bioinformatics

Leah Kago, Brachiaria project

Leonard Kiche, IGSS platform

Lucy Muthui, SegoliP

Martin Kanyeki, IGSS platform

Martina Kyalo, Capacity building

Mercy Chepngetich, IGSS platform

Moses Githaiga, IGSS platform

Phillis Ochieng, Mycotoxin and nutritional analysis platform

Samuel Ng'ang'a, IGSS platform

TECHNICAL SUPPORT

Agnes Mburu, Technical management assistant

Dalmas Ngere, Laboratory assistant

Edwin Onyiego, Greenhouse assistant

Everlyn Onyango, Technical assistant, Central Core

Francis Gatehi, Laboratory assistant

Julius Osaso, Diagnostic platform manager

Linnet Agiza, Laboratory assistant

Manasses Mwaura, Technical assistant, Central Core

Mary Odiyo, Laboratory assistant

Mary Wambugu, Technical support coordinator

Michael Ominde, Laboratory assistant

PROGRAM SUPPORT

David Barasa, Assistant to project manager

Edith Ng'ang'a, Program accountant*

Elijah Mwaura, Program accountant

Ethel Makila, Communications officer*

Helen Altshul, Development partnerships specialist*

Leah Ndungu, Program coordinator*

Rachael Mwangi, Project manager

Valerian Aloo, Capacity building officer

**Left BecA-ILRI Hub in 2017*

SegoliP: Sequencing, Genotyping, Oligo Synthesis and Proteomics unit

Staff retreat 2017

BecA-ILRI Hub staff and research fellows held a one day team building exercise at the Maasai Lodge in Kajiado County.

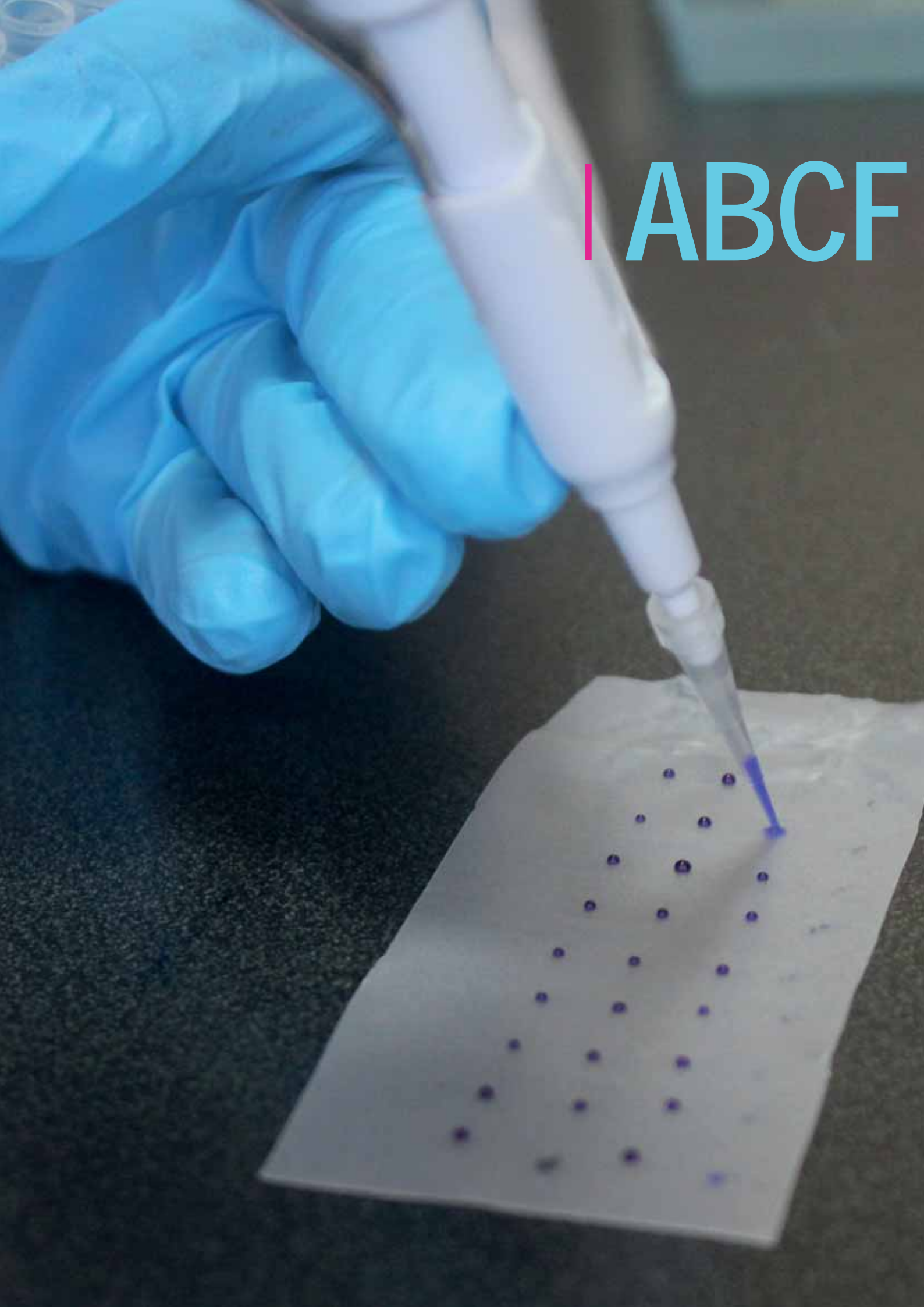




FIN
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JOHNSON

| ABCF



fellows

BURUNDI

Lionel Nyabongo, Scientist, National Veterinary Laboratory.
Project: Molecular characterization of Theileria parva.

CAMEROON

Chelea Matchawe, Scientist, Research Centre for Food and Nutrition. *Project: Genetic and antibiotic resistance profile of nontyphoidal Salmonella isolated from cattle, beef carcass, personnel and slaughterhouse environment at the Yaounde Abattoir.*

Arouna Ngapagna, Assistant professor in epidemiology and infectious diseases, University of Des Montagnes. *Project: Epidemiology and ecology of the African swine fever in agroforest system: case of Cameroon.*

DEMOCRATIC REPUBLIC OF CONGO

Lyna Tongo, Scientist, Plant Clinic International. *Project: Detection and distribution of banana bunchy top virus towards two types of bananas in Equateur province in DRC.*

Bintu Ndusha, Assistant lecturer, Universite Evangelique en Afrique. *Project: Genetic diversity and competitiveness of effective indigenous rhizobia nodulating soybean in South Kivu soils (eastern DRC).*

ETHIOPIA

Edossa Wayima, Assistant professor, Madda Walabu University. *Project: Molecular identification and characterization of mechanisms for tolerance to aluminium toxicity in durum wheat.*

Addisu Addis, Assistant professor, University of Gondar. *Project: Genetic diversity and population structure of Ethiopian indigenous chicken ecotypes.*

Tadesse Ergie, Researcher, Ethiopian Institute of Agricultural Research (EIAR). *Project: Characterization and genetic diversity analysis of coffee (Coffea arabica L.) accessions, advanced selections and released varieties in Ethiopia.*

Zerihun Tarekegn, Scientist, Ethiopian Institute of Agricultural Research (EIAR). *Project: Association and diversity study of Ethiopian bread wheat genotypes using validated KASP assay for genes underlying important economic traits.*

Agraw Abde, Researcher, Amhara Regional Agricultural Research Institute. *Project: Genetic diversity, genetic admixture analysis and designing of breeding strategies for Ethiopian short fat-tailed sheep.*

KENYA

Moses Orwe, Researcher, KALRO. *Project: Identification and expression of priority homologues of Mycoplasma mycoides mycoides (Mmm) in Mycoplasma capricolum capripneumonia (Mccp).*

Naomi Mumo, Researcher and lecturer, Jomo Kenyatta University of Agriculture and Technology. *Project: Characterization and identification of papaya ringspot virus affecting papaya (Carica papaya L.) in Kenya.*

Angela Cherunya, Researcher, KALRO. *Project: Identification and characterization of rust and leaf spot diseases of Brachiaria grass in Kenya.*

Ruth Amata, Researcher, KALRO. *Project: Maize microbiome to enhance overall plant fitness, yield and mycotoxin reduction.*

John Sitienny, Researcher, KALRO. *Project: Maize microbiome to enhance overall plant fitness, yield and mycotoxin reduction.*

James Barasa, Lecturer, University of Eldoret. *Project: DNA barcoding of indigenous catfishes of western Kenya for improved utilization.*

Samuel Mwangangi, Lecturer, University of Eldoret. *Project: Omic-based characterization of biogas reactor microbiome in eastern and central regions of Kenya.*

Irene Ogali, Research officer, Veterinary Research Institute. *Project: Metagenomic characterization of viral diversity in domestic pigeons in Kilifi, Kenya.*

ABC F RESEARCH FELLOWS *...continued*

Eunice Wainaina, Senior agriculture officer, Ministry of Agriculture Livestock and Fisheries-Kenya. *Project: Marker assisted breeding for beta carotene content among orange-fleshed sweet potato clones.*

Harrison Lutta, Scientist, KALRO. *Project: Development of an antibody-based assay that differentiates cattle naturally infected with contagious bovine pleuropneumonia (CBPP) from those vaccinated with a recombinant vaccine.*

George Abong, Lecturer, University of Nairobi. *Project: Phytochemicals content of popular Kenyan orange-fleshed sweet potato varieties and their stability in selected food preparations.*

Juliana Cheboi, Tutorial fellow, University of Nairobi. *Project: Evaluation of elite pigeon pea (*Cajanus cajan*) genotypes for nutritional quality and biochemical factors.*

Moses Nyongesa, Principal research officer, KALRO. *Project: Profiling effectors in Kenyan *Phytophthora infestans* population to interpret pathogen aggressiveness to local potato (*Solanum tuberosum*) cultivars.*

Lilian Okiro, Senior laboratory technologist, Egerton University. *Project: Detection of *Ralstonia solanacearum* populations by loop-mediated isothermal amplification.*

Mercy Wamalwa, Lecturer, Egerton University. *Project: Association and diversity study of Kenyan bread wheat genotypes using validated KASP assay for genes underlying important economic traits.*

Nicholas Owiro, Research assistant, University of Eldoret. *Project: Molecular characterization of mycotoxigenic fungi, mycotoxins contamination and aflatoxin awareness in plant-based indigenous chicken feeds in Western Kenya.*

Charles Orek, Lecturer, South Eastern Kenya University. *Project: Evaluation and selection of improved cassava genotypes based on their response to major cassava viruses in Kenya.*

Richard Dooso, Student, University of Nairobi. *Project: Assessment of the toxigenicity potential and the associated genomic regions in populations of *Aspergillus flavus* from different maize growing areas of Kenya.*

David Muruu, Researcher, JKUAT. *Development of in vitro conservation and a platform for supply of clean planting materials for diverse taro cultivars.*

Mercy Kepue, Researcher, JKUAT. *Project: Genome-wide SNP discovery, somatic embryogenesis and regeneration of taro.*

NIGER

Moussa Ousseini, Livestock technician and research associate, University Abdou Moumouni. *Project: Molecular characterization and phylogeny of local chicken populations in Niger.*

NIGERIA

Bunmi Olasanmi, Lecturer, University of Ibadan. *Project: Marker-assisted selection for improvement of cassava (*Manihot esculenta* Crantz) for beta-carotene content and cassava mosaic disease resistance.*

SOMALIA

Abdirahim Ahmed, Researcher, IGAD Sheikh Technical Veterinary School. *Project: Bruce prevalence and diversity of *Brucella* in small ruminant in Awdal region, Somaliland (north Somalia).*

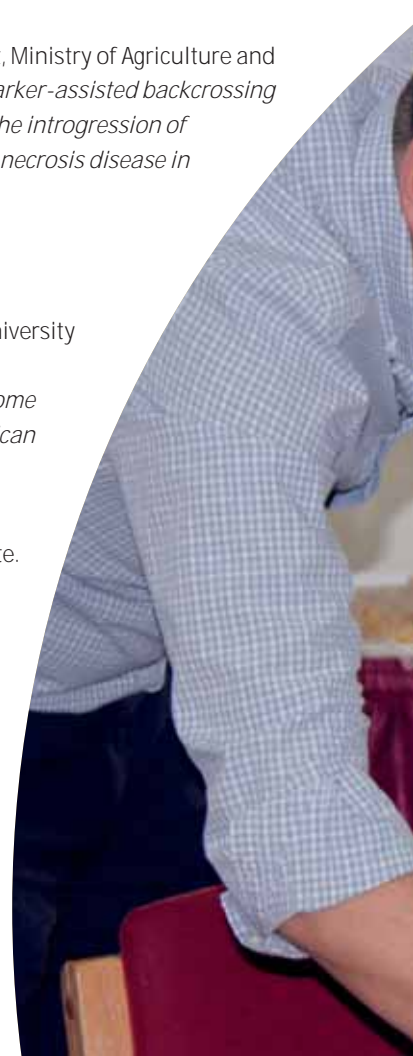
SOUTH SUDAN

Luka Opio, Senior research scientist, Ministry of Agriculture and Food Security. *Project: The use of marker-assisted backcrossing and doubled haploids to speed up the introgression of genes for resistance to maize lethal necrosis disease in commercially adapted maize lines.*

TANZANIA

Emma Njau, Researcher, Sokoine University of Agriculture. *Project: Screening, characterization and complete genome sequencing of sylvatic outbreak African swine fever virus in Tanzania*

Valentino Urassa, Researcher, Tanzania Livestock Research Institute. *Managing strategies to combat aflatoxigenic (*Aspergillus* spp) and reduce contamination in cereals for animal feeds.*



John Mlay, Researcher, Tanzania Livestock Research Institute. *Project: Fungal endophytes of Buffel grass (*Cenchrus ciliaris*) seeds in Tanzania.*

UGANDA

Joanne Adero, Research assistant, National Crops Resources Research Institute. *Project: Molecular variability of sweet potato viruses in Uganda.*

Julius Sserumaga, Research scientist, National Crops Resources Research Institute. *Project: Use of mature kernel screening assay in dissection of the genetics for aflatoxin accumulation resistance in maize.*

Geoffrey Otim, Laboratory technician, Gulu University. *Project: Development and validation of a new diagnostic tool for detection and characterization of sweet potato viruses in East Africa using next-generation sequencing.*

Godfrey Wokorach, Research assistant, Gulu University. *Project: Development and validation of a new diagnostic tool for detection and characterization of sweet potato viruses in East Africa using next-generation sequencing.*

Cristobal Uauy (left, standing) and Brande Wulff (standing) from JIC support participants during a workshop at BecA-ILRI Hub.



| Publi



cations

Ali, A.M., Salih, D.A., Njahira, M.N., Hassan, S.K. El Hussein A.M et al. 2017.

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Ayagirwe, B., Meutchieye, F., Djikeng, A., Skilton, R. Osama, S. et al. 2017.

Genetic diversity and structure of domestic cavy (*Cavia porcellus*) populations from smallholder farms in southern Cameroon. *Animal Production* 19(1):1–12. <http://hdl.handle.net/10568/90640>.

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Djugap, F.J., Nzong, A.C., Kyalo, M., Achiangia, N.P., Galani, Y.J.H. et al. (2017). Morphological and molecular identification of pathogenic fungi of *Monodora myristica* Dunal kernels and their response to different phytoextracts. *International Journal Advance Agricultural Research* 5(5): 66–75.

Egual, T., Birungi, J., Asrat, D., Njahira, M.N., Njuguna, J. et al. 2017.

Genetic markers associated with resistance to beta-lactam and quinolone antimicrobials in non-typhoidal salmonella isolates from humans and animals in central Ethiopia. *Antimicrobial Resistance & Infection Control* 6(1):13.

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Antimycoplasmal activities of compounds from *Solanum aculeastrum* and *Piliostigma thonningii* against strains from the *Mycoplasma mycoides* cluster. *Frontiers in Pharmacology* 8. Doi: 10.3389/fphar.2017.00920.

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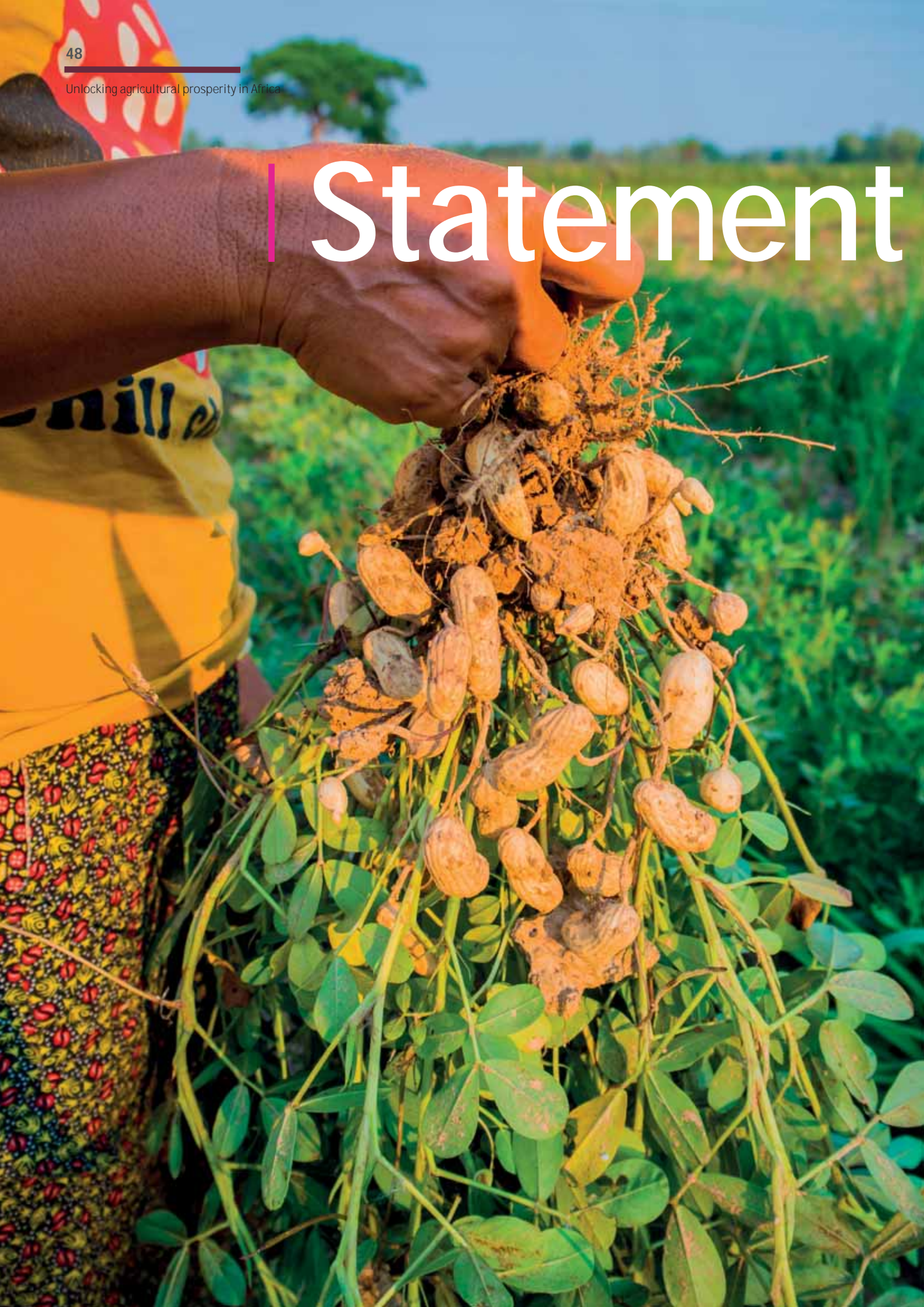
Yohannes, T., Ngugi, K., Ariga, E., Ahonsi, M., Yao, N. et al. 2017.

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Statement

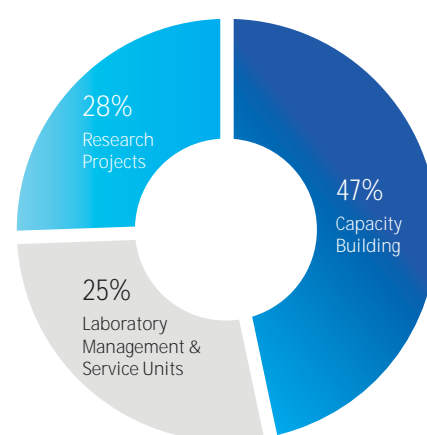


of accounts

The tables and charts below represent broken down information and figures representing BecA-ILRI hub's activity expenditure in the year 2017.

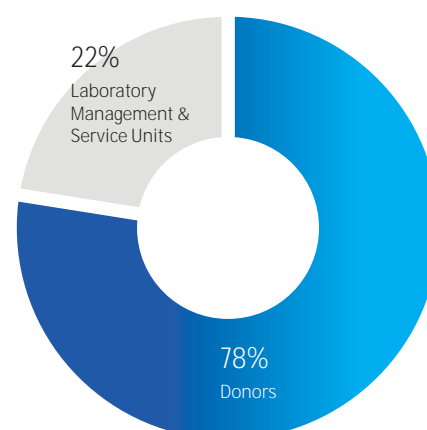
Expenditure by activity

	USD '000	Percentage
Capacity building	4,730	47%
Research projects	2,812	28%
Laboratory management and service units	2,574	25%
Total expenditure	10,117	100%



Income analysis

	USD '000	Percentage
Donors	7,852	78%
Laboratory management and service units	2,265	22%
Total income	10,117	100%



Left to right, Godelieve Mukamurenzi (RAB), Samuel Mutiga (BeCA-ILRI Hub), Arnold Mushongi (Agricultural Research Institute, Tanzania) and Esther Kimani (KALRO) are working together on their "research problem" during the proposal development training at BeCA-ILRI Hub.



Acronyms

ABCF	The Africa Biosciences Challenge Fund
ACACIA	Alliance for Accelerated Crop Improvement in Africa
AWARD	African Women in Research and Development
BBSRC	Biotechnology and Biological Sciences Research Council
BCMNV	Bean Common Mosaic Necrosis Virus
BCMV	Bean Common Mosaic Virus
CAADP	Comprehensive Africa Agriculture Development Programme
CIMMYT	International Maize and Wheat Improvement Centre
CIP	International Potato Centre
CMD	Cassava Mosaic Disease
DRC	Democratic Republic of Congo
IFPRI	International Food Research Institute
IGSS	Integrated Genotyping Service and Support
ILRI	International Livestock Research Institute
JIC	John Innes Centre
KALRO	Kenya Agriculture and Livestock Research Organization
KASP	Kompetitive allele specific PCR
LANAVET	National Veterinary Laboratories
MAFS	Ministry of Agriculture and Food Security
MLND	Maize Lethal Necrosis Disease
NaCRRI	National Crops Resources Research Institute
NARS	National Agricultural Research Systems
NEPAD	New Partnership for Africa's Development
NM-AIST	Nelson Mandela African Institution of Science and Technology
OFAB	Open Forum on Agricultural Biotechnology
PIPs	Professional Internships for PhD Students
PPR	Pestes Petit de Ruminant
RAB	Rwanda Agriculture Board
TALIRI	Tanzania Livestock Research Institute





Awadia Mousa, ABCF Fellow from the University of Khartoum conducting her research towards the control of malignant ovine theileriosis.

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Andy Breakspear (JIC) and Leah Kago (Research Associate) during the 'Golden Gate' training at the BecA-ILRI Hub.





Back page Mary Wambugu at the bench working on cassava virus strains, a project in collaboration with North Carolina State University.

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The Biosciences eastern and central Africa-International Livestock Research Institute (BecA-ILRI hub) platform is a shared agricultural research and biosciences facility co-created by ILRI and the African Union's New Partnership for Africa's Development (NEPAD). It increases access to world-class laboratories for African and International scientists conducting research on African agricultural challenges. The BecA-ILRI Hub is a focal point for learning, interaction and strategic research towards delivering products to improve food and nutritional security in Africa. hub.africabiosciences.org

NEPAD Agency is the implementing agency of the African Union, facilitating and coordinating the development of continent-wide programmes and projects, mobilising resources and engaging the global community, regional economic communities and countries in transforming Africa. NEPAD Agency is contributing to Africa's Agenda 2063 goals, the continent's long-term development framework for socio-economic transformation. nepad.org

The International Livestock Research Institute (ILRI) works to improve food security and reduce poverty in developing countries through research for better and more sustainable use of livestock. ILRI is a CGIAR research centre. It works through a network of regional and country offices and projects in East, South and Southeast Asia, and Central, East, Southern and West Africa. ilri.org

CGIAR is a global agricultural research partnership for a food-secure future. Its research is carried out by 15 research centres in collaboration with hundreds of partner organizations. cgiar.org

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