

A man with short dark hair and a goatee, wearing a white lab coat over a red shirt and a blue lanyard, is focused on his work. He is wearing blue nitrile gloves and is using a pipette to transfer liquid into a multi-well plate. The background is a blurred laboratory setting with various pieces of equipment and bright lighting.

**Accelerating research
for development impact
through partnerships**

The BecA-ILRI Hub 2015 Annual Report

mobilizing biosciences in and for Africa's agricultural development
hub.africabiosciences.org



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.

Accelerating **research** for **development impact** through **partnerships**

The BecA-ILRI Hub 2015 Annual Report

Biosciences eastern and central Africa-International Livestock Research Institute (BecA-ILRI) Hub
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**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.

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IN THIS ISSUE, YOU WILL READ ABOUT:

Research at the BecA-ILRI Hub that brings together national agricultural research systems (NARS), advanced research institutions, regional agencies and non-governmental organizations from across the globe;

Research findings that are influencing policy for the management of economically significant crop and livestock diseases and development of livestock improvement programs, and advancing the quest to tackle crop and livestock production constraints;

Contribution towards transforming national crop and animal breeding programs in Africa through the provision of access to cutting edge technologies and research-related services, capacity building activities, and transfer of technologies from advanced research institutions to national programs;

Strategic partnerships with governments, private sector, universities and research institutions that are broadening the range of research and capacity strengthening programs at the BecA-ILRI Hub and facilitating the mentoring of a larger number of African scientists;

Successes in mobilizing bioscience for agricultural development in Africa by strengthening the capacity of regional researchers and institutions, and the revitalized strategy to enhance engagement with NARS in prioritizing their research agenda;

Engagement with the advisory panel and donor-support group that is guiding the BecA-ILRI Hub as a provider of agricultural bioscience support in Africa;

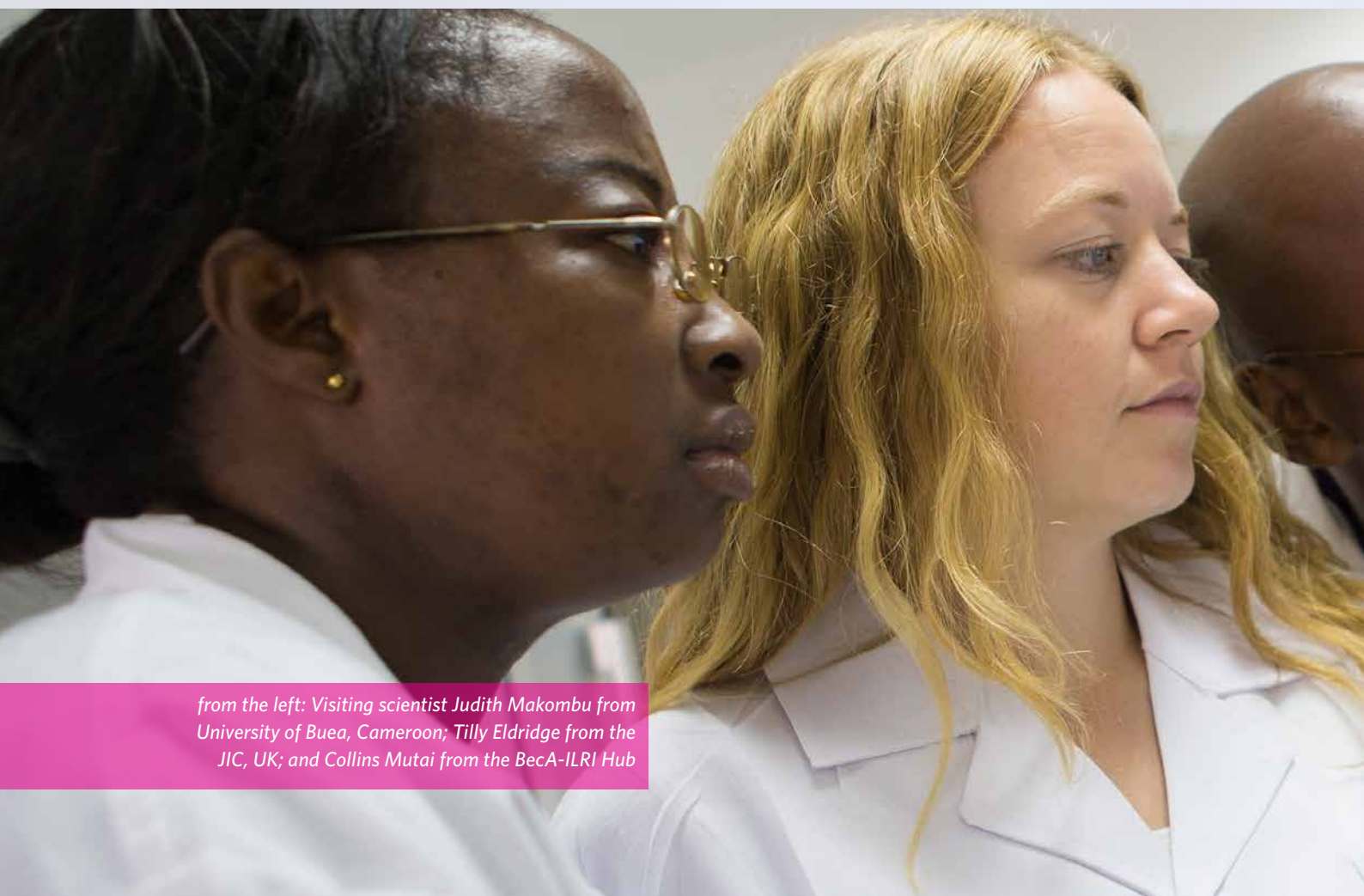
A summary of the BecA-ILRI Hub's human and financial resources.

By all accounts, 2015 was a milestone year in which three defining events began to shape the global economic and development landscapes. The Third International Conference on Financing for Development in Addis Ababa, Ethiopia in July provided a framework for universal solidarity in developing new strategies to finance development beyond 2015; the adoption of the United Nation's Sustainable Development Goals (SDGs) in September set the agenda for concerted global efforts to address the root causes of poverty and the universal needs for development that works for all people; and the United Nations conference on climate change and the resulting Paris agreement in November saw 195 countries adopting the first-ever universal, legally-binding global climate deal.

It is against the backdrop of such global initiatives that the Biosciences eastern and central Africa-International Livestock Research

Institute (BecA-ILRI) Hub reports on progress made in 2015. The focus remained on the implementation of the 2013–2018 business plan: aligning opportunities for joint research with international and national partners, support to CGIAR Research Programs and with the implementation of the Science Agenda for Agriculture in Africa (S3A). The BecA-ILRI Hub contribution to enhanced biosciences capabilities for national agricultural research systems (NARS) grew steadily as the research supported through the Africa Biosciences Challenge Fund (ABCF) fellowship program represented a robust and diverse portfolio of agricultural development priorities in sub-Saharan Africa.

Furthermore, triangular partnerships established between the BecA-ILRI Hub, African NARS and international research institutions and universities supported the creation of a continuum of



from the left: Visiting scientist Judith Makombu from University of Buea, Cameroon; Tilly Eldridge from the JIC, UK; and Collins Mutai from the BecA-ILRI Hub

collaborative research, capacity building and technology transfer activities. These alliances are setting the stage to bring to bear the most advanced research and innovations in smallholder farming systems in Africa. For example, through collaboration between the BecA-ILRI Hub and the Texas A&M University (USA), the commercial maize milling sector in Kenya is receiving support in accurately testing for aflatoxins in maize flour, thus reducing aflatoxin risk and improving food safety for an estimated 16 million consumers.

Additionally, by leveraging a public-private partnership with Diversity Arrays Technology (DARt) Pty. Ltd. (Canberra, Australia), the BecA-ILRI Hub made important progress in establishing the most technologically advanced genomics platform in sub-Saharan Africa which has applications in crop breeding and livestock genetics. By establishing, strengthening and applying cutting-edge technology platforms

and services, the BecA-ILRI Hub continues to facilitate the conduct and use of high-end biosciences research by other CGIAR centres and their partners in Africa. The food and nutritional evaluation laboratory (FANEL) of the International Potato Center (CIP), hosted by the BecA-ILRI Hub's nutritional analysis and mycotoxin diagnostics platform, has availed new capabilities in various food nutritional and safety analyses to African NARS.

Overall, through diverse innovative approaches, the BecA-ILRI Hub has continued to drive research addressing key agricultural development challenges, including increased productivity, food safety and climate change mitigation. As you read the highlights of the impact already achieved, it is our hope that you will be reinvigorated in your commitment to joining the BecA-ILRI Hub in mobilizing biosciences as a means of transforming African agriculture.

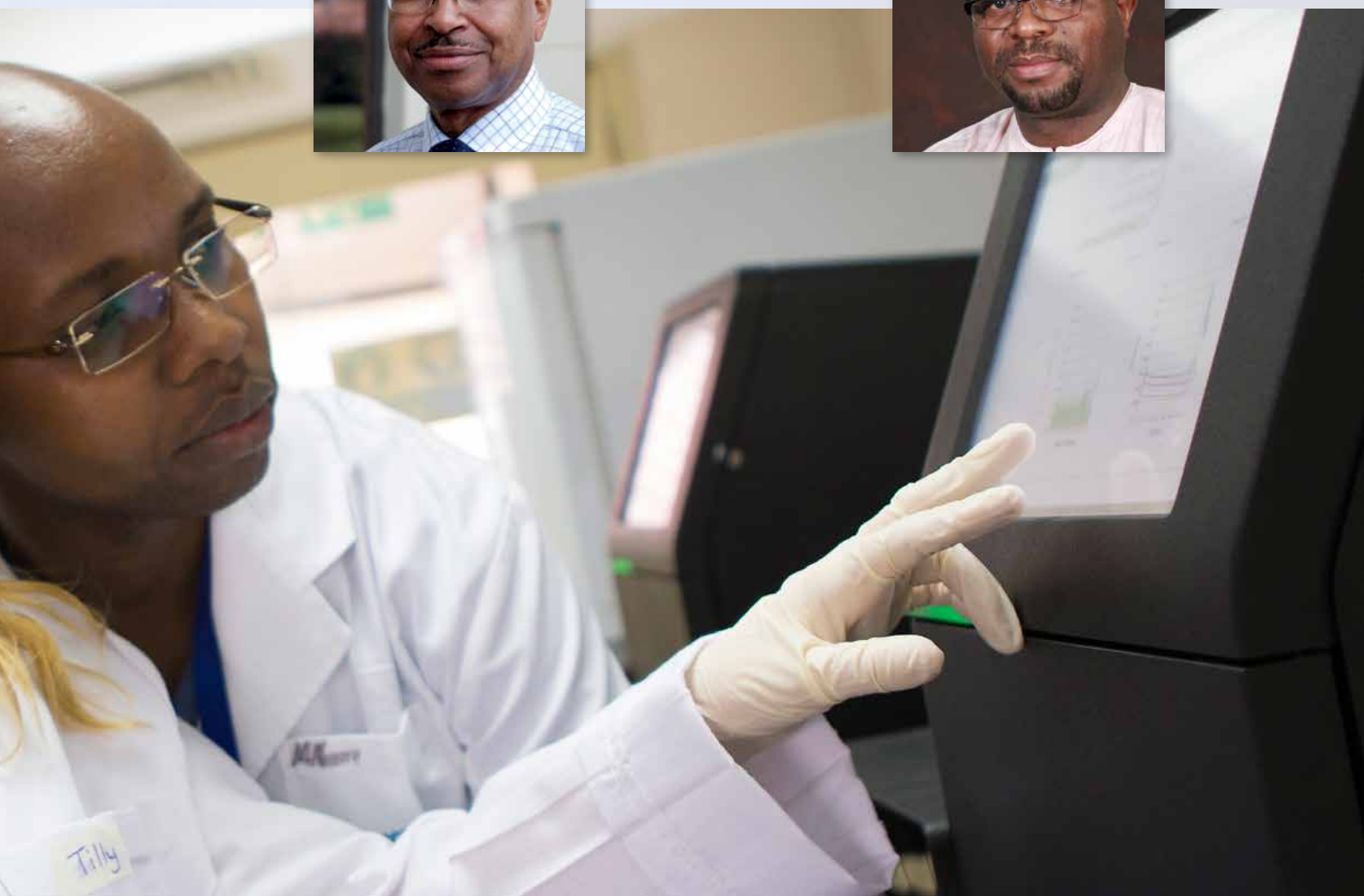
JIMMY SMITH

Director General, ILRI



APPOLINAIRE DJIKENG

Director, BecA-ILRI Hub



Building a toolbox for managing viral diseases in common beans

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To strengthen the capacity of the team working towards sustainable disease management in beans, Josiah Mutuku, a post-doctoral scientist at the BecA-ILRI Hub spent time in the University of Cambridge, UK, learning advanced methods of data analysis. Mutuku was embedded within Professor Sir David Baulcombe's bioinformatics team acquiring skills that were applied in the analysis of RNA-sequencing data generated from virus-infected bean plants.

The analysis identified a set of genes showing a differential response to viral infection compared to those in healthy plants. Further analysis will lead to the identification and characterization of candidate genes that could underpin the breeding of disease-resistant beans. The information and tools developed through this project will be disseminated to NARS partners, scientists in Africa, bean growers and consumers through the Pan-Africa Bean Research Alliance, a network of the national bean research programs of 29 African countries.



The Bean project is funded through a grant awarded by the Biotechnology and Biological Sciences Research Council (BBSRC) under the Sustainable Crop Production Research for International Development (SCPRID) program, a joint multi-national initiative of BBSRC and the UK Government's Department for International Development (DFID), together with (through a grant awarded to BBSRC) the Bill & Melinda Gates

Foundation (BMGF), and the Department of Biotechnology (DBT) of India's Ministry of Science and Technology.

Partners in the project include the University of Cambridge, Rothamsted Research, UK; the Eastern and Central African Bean Research Network (ECABREN) coordinated by the International Center for Tropical Agriculture (CIAT) Uganda; and the BecA-ILRI Hub.

The durable rice blast resistance for Africa project is funded through a grant awarded by the BBSRC under the SCPRID program, a joint multi-national initiative of BBSRC and the DFID, together with (through a grant awarded to BBSRC) the BMGF, and the DBT.

Partners in the project include the University of Exeter, UK; the University of Arkansas, USA; the Kenya Agricultural and Livestock Research Organization (KALRO); Makerere University, Uganda; the Ohio State University, USA; Station de Recherches de Farako-Bâ, Burkina Faso; and the BecA-ILRI Hub.

Post-doctoral scientist Samuel Mutiga from University of Arkansas, USA, working at the BecA-ILRI Hub



New strategies to control rice blast in sub-Saharan Africa

Studies on the fungus that causes rice blast have enabled the research team to initiate a breeding strategy against the devastating disease. The pathogen was collected from rice fields in East and West Africa and characterized at the BecA-ILRI Hub.

The *Pi9* gene—found to provide resistance against 96% of isolates of the rice blast pathogen, *Magnaporthe oryzae*—was introduced to three major African rice cultivars, including NERICA 15*, NERICA 2 and F6-36. The resulting crosses will be evaluated in the blast hotspots in selected sub-Saharan African countries during the first half of 2016.

Samuel Mutiga, a post-doctoral scientist at Professor Jim Correll's Lab at the University of Arkansas and a visiting scientist at the BecA-ILRI Hub, embarked on the establishment of a fungal biobank to store the blast pathogen collected from across Africa. The biobank will facilitate efficient screening of blast resistance in African rice germplasm and contribute to the development of a regional disease monitoring framework; breeding strategies and disease control measures, including quarantine systems, will safeguard regions from the introduction of new virulent strains through rice trade.

*NERICA, or New Rice for Africa, is a group of rice varieties developed by crossing hardy African species *Oryza glaberrima*, and higher yielding Asian species *Oryza sativa*. These interspecific rice varieties were developed by the Africa Rice Center (AfricaRice).

Alternative forage options for improved livestock productivity

For the past four years, the BecA-ILRI Hub has been leading research to increase the availability of quality forage for smallholder farmers using Brachiaria grass. With the participation of smallholder farmers in Kenya and Rwanda, the program identified four improved Brachiaria varieties adapted to drought and low fertility soils.

6 The on-farm evaluations of these varieties (Basilisk, MG-4, Piatá and Xaraés) show that the introduction of Brachiaria grass extends feed availability by three months during the dry season. Additionally, the milk production of cattle has increased by 15–100% and the average daily body weight gain exceeds 50% in young animals. Evaluations are being conducted across various agro-ecological zones of Kenya and Rwanda in collaboration with national partners and Rwanda Agriculture Board (RAB), and involve over 3,000 farmers.

In addition to the evaluation of Brachiaria grass varieties, research on beneficial microorganisms (endophytes) living within healthy tissues of the grass and other plant associated microbial communities is

ongoing at the BecA-ILRI Hub. One of the bacterial strains under investigation has been found to increase total biomass production by up to 39% in a greenhouse environment, while other bacterial strains are capable of solubilizing phosphorous. Phosphorous is a major nutrient necessary for plant growth and development, but is scarce in the majority of soils in sub-Saharan Africa. The use of these bacteria to increase mineral phosphate solubilization and enhance phosphorous availability to plants is being explored.

The majority of bacterial strains isolated from Brachiaria grass have been found to possess two or more properties beneficial to host plants, including enhancing biomass production, stimulating plant hormone production, increasing nutrient solubility, and improving drought tolerance, soil fertility improvement and overall plant health. The beneficial endophytes will be used in the development of Brachiaria varieties better suited to the African environment.

The program on climate-smart Brachiaria grasses for improving livestock production in East Africa is funded by the government of Sweden/Sida. The research is led by the BecA-ILRI Hub and implemented in partnership with the KALRO, RAB, CIAT and Grasslanz Technology Limited, and AgResearch (New Zealand)





Visiting scientists Fatma Hussein from Nelson Mandela African Institution of Science and Technology (NMAIST), Tanzania and Tadesse Haile from National Agricultural Research Institute, Eritrea work at the BecA-ILRI Hub. Looking on are Tilly Eldridge, JIC and Collins Mutai, BecA-ILRI Hub

Fighting maize lethal necrosis disease in East Africa

Reports of the fast spread of maize lethal necrosis disease (MLND) in eastern and central Africa have led to redoubled efforts to develop a regional control strategy for the disease. The BecA-ILRI Hub team is part of a regional consortium involving KALRO, the University of Nairobi (UoN) and the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) that is developing a control strategy for MLND. The consortium has already set the stage to develop tools for MLND management in seven countries: Burundi, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania and Uganda.

In addition to the regional effort, a BecA-ILRI Hub sponsored regional community of practice

(CoP) has been established with the aim of combating the disease. Researchers from NARS in the CoP are leading various components of research at the BecA-ILRI Hub, including virus detection in maize samples from Tanzania by Fatma Hussein, an agricultural research officer at Tengeru Horticultural Research and Training Institute, Tanzania; studies on the evolutionary relationships between isolates from across Kenya by Francis Mwatuni, officer in charge of the plant quarantine and biosecurity station, Kenya Plant Health Inspectorate Service (KEPHIS); and interactions between key proteins of the two viruses causing the necrosis by Anne Ndanu, a PhD student of biochemistry and biotechnology at the Kenyatta University in Kenya.

Renewed commitment to control African swine fever

Since 2012, the BecA-ILRI Hub and a range of partners supported by the Australian Government has: contributed to a better understanding of the pig production systems in East Africa and transmission patterns of African swine fever (ASF) in smallholder farming systems; and proposed a set of control measures for the disease. Building on the research by the BecA-ILRI Hub and other consortia, a regional control strategy for ASF has now been developed and validated by key stakeholders in the pig industry in Africa.

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Key stakeholders in the pig industry from 15 countries in Africa met in Burkina Faso in November 2015 to validate a regional strategy on implementation plan for the control of ASF. The strategy was developed by a taskforce comprising the ILRI Biosciences team, the BecA-ILRI Hub, the Food and Agriculture Organization of the United Nations (FAO)

and African Union-InterAfrican Bureau for Animal Resources (AU-IBAR).

Participants at the meeting were drawn from Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Ethiopia, Kenya, Malawi, Tanzania, Togo, Uganda, Zambia and Zimbabwe; national, regional and global research institutes including National Animal Health Diagnostic and Investigation Center in Ethiopia, Laboratoire National Veterinaire in Cameroon, Institut Sénégalais de Recherches Agricoles in Senegal, University of Pretoria in South Africa, the Eastern Africa ASF Working Group; and international organizations including FAO, ILRI, AU-IBAR and the AU-Pan African Veterinary Vaccine Centre.



The ASF diagnostics, surveillance, epidemiology and control research is funded by the Australian government and implemented in partnership with Ministry of Agriculture, Animal Industries and Fisheries, Uganda; Ministry of Livestock Development, Kenya; Centro de Investigación en Sanidad Animal, (and FAO and EU ASF Reference Centre) Madrid, Spain; and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia.



The *Harnessing genetic diversity for improved goat productivity* project is funded by the government of Sweden and implemented in partnership with the Ethiopian Institute of Agricultural Research (EIAR); Institute of Biodiversity Conservation, Ethiopia; Tigray Regional Agricultural Research Institute, Ethiopia; Amhara Regional Agricultural Research Institute, Ethiopia; Ethiopian Wildlife Conservation Authority; South Regional Agricultural Research Institute, Ethiopia; University of Dschang, Cameroon; Institute for Agricultural Research for Development (IRAD), Cameroon; Ministry of Livestock Fisheries and Animal Industries' Small Ruminant Support Program, Cameroon; and NMAIST, Tanzania.

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Innovation platforms building evidence to influence livestock production policies

In Cameroon, the innovation platform (IP)* approach was used to address productivity challenges in the goat value chain including farmer practices and management of goat genetic resources. The project team identified, trained and provided support to a regional and four national goat IPs. IP members were drawn from various stakeholder groups including policymakers, goat keepers, traders, researchers, private bodies and facilitation organizations.

As a result of activities undertaken through the various goat IPs, there is increased interest in the goat value chain as a means to strengthen the livestock subsector in Cameroon. Based on the lessons learned, the Cameroonian national agricultural research institution, Institut de Recherche Agricole pour le Développement, initiated goat-breeding research activities in the Mankon and Garoua stations. The IPs developed as part of the project will continue to be the vehicle for innovations in goat improvement in the country.

Value addition to enhance consumption of nutritious indigenous crops

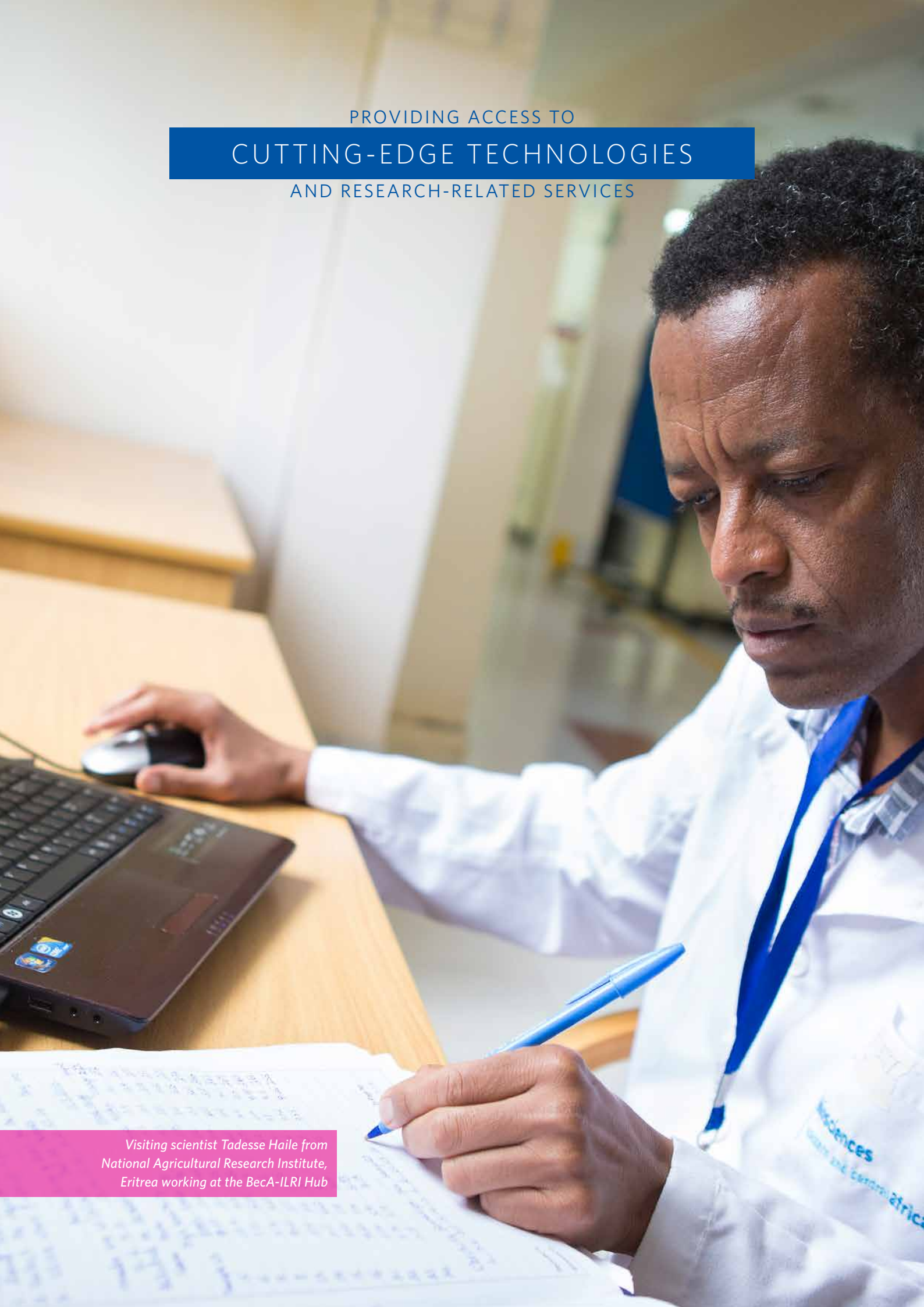
Since 2011, a partnership conducting research on the improvement of amaranth, a highly nutritious and drought-tolerant traditional vegetable, has introduced improved varieties of the crop as well as enhanced agronomic practices among smallholder farmers in Kenya and Tanzania. As a result, farmers have experienced higher yields of grain and vegetable amaranth of up to 250% and increased household income; and there has been enhanced domestic consumption in the project target areas.

Efforts towards strengthening the amaranth value chain included the training of 17 composite flour millers conducted jointly by the Jomo Kenyatta University of Agriculture and Technology (JKUAT) in Kenya and the Global Alliance for Improved Nutrition. The training aimed at enhancing the capacity of the grain millers to formulate composite flours for better nutrition and increased profitability.

The amaranth project: Adding nutrition to African diets through low-cost sustainable processing is funded by the Australian government and implemented in partnership with the JKUAT in Kenya; Sokoine University of Agriculture, Tanzania; The World Vegetable Centre, Tanzania; the CSIRO, Australia; and Annico Enterprises, Kenya.



PROVIDING ACCESS TO
CUTTING-EDGE TECHNOLOGIES
AND RESEARCH-RELATED SERVICES



Visiting scientist Tadesse Haile from
National Agricultural Research Institute,
Eritrea working at the BecA-ILRI Hub

Supporting modernization of crop and animal breeding programs in Africa

The molecular breeding platform at the BecA-ILRI Hub has continued to enhance plant breeding and livestock genetics and genomics in the region. Through the operation and management of the Integrated Breeding Platform (IBP) regional hub, the BecA-ILRI Hub has provided a breeding management system (BMS) for the efficient management of breeding activities. Eleven training workshops involving 200 participants from Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda have so far been conducted. As a result, key African breeding programs, including the Agricultural Research Corporation (ARC) in Sudan, the EIAR and the National Crops Resources Research Institute (NaCRRI) in Uganda, have adopted and are using the tool.

Outreach activities under IBP and the demand-led initiatives enabled the identification of key constraints towards the modernization of African breeding programs, including the integration of DNA marker technology, the lack of facilities and limited skill set in using the technology. These constraints are addressed under the Integrated Genotyping Service and Support (IGSS) platform.

An approach to breeding which links market demands with breeding goals is being provided through the demand-led variety design*, an initiative in which the BecA-ILRI Hub is among the implementing partners. The third training workshop on demand-led variety design was conducted in November with participation of 13 African national crop breeders from Eritrea, Ethiopia, Kenya, Rwanda and Uganda.

*The demand-led variety design initiative is a partnership between the Australian Centre for International Agricultural Research, Syngenta Foundation for Sustainable Agriculture (SFSA) and the Crawford Fund. The project is being led by the University of Queensland Global Change Institute and SFSA with implementing partners including African Centre for Crop Improvement; Alliance for a Green Revolution in Africa (AGRA); ASARECA; the BecA-ILRI Hub, West and Central African Council for Agricultural Research and Development (CORAF/WE CARD); Forum for Agricultural Research in Africa (FARA); Regional Universities Forum for Capacity Building in Agriculture; and West Africa Centre for Crop Improvement (WACCI)—University of Ghana.

BecA-ILRI Hub post-doctoral scientist Nasser Yao working in a green house



Kick-starting the Integrated Genotyping Service and Support platform

The key focus for the IGSS platform in 2015 was to understand the needs of national and international plant breeders, fill in the gaps identified under the IBP and the demand-led initiative, as well as transfer of technology to the BecA-ILRI Hub.

Five trainees to be embedded in the IGSS at the BecA-ILRI Hub commenced training on the Diversity Arrays Technology pipeline (DARTSeq) at its headquarters in Canberra, Australia. To enable them master key skills needed for the operation of the platform, a set of mini projects were designed for the application of genomic tools to support crop breeding programs and livestock genetics research. The mini-projects were co-designed with NARS breeding programs,

CGIAR centres, regional and non-governmental organizations.

Outputs from the projects include molecular profiling of key rice germplasm to identify marker panels that will aid the diagnosis of economically significant diseases; study of common genetic variants associated with resistance to cassava brown streak disease and cassava mosaic disease; and facilitate the mapping of candidate genes for emerging and severe diseases in maize and sweet potato.

Through these initial services, the BecA-ILRI Hub has established a client base for the IGSS platform and also developed a clearer understanding of the challenges and opportunities in providing the services and support to breeding programs in Africa.

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The IGSS is funded by the BMGF and implemented in collaboration with Diversity Arrays Technology (DART) Pty. Ltd, Australia.



Deploying genomics to accelerate agricultural research for development

Harnessing the sequencing power offered by the next generation and the gold standard Sanger sequencing platforms, the BecA-ILRI Hub is now positioned as a leading genomic centre in sub-Saharan Africa. The BecA-ILRI Hub genomics capabilities are being deployed to support research for development projects and also offer sequencing and genotyping services to a wide range of users in Africa and beyond. In 2015 alone, over 100 gigabytes of sequence data was generated with applications ranging from diversity assessment, diagnostics and improvement of crops, forages and livestock, full and partial genome sequencing (viruses, bacteria, fungi) metagenomes and transcriptomes analyses.

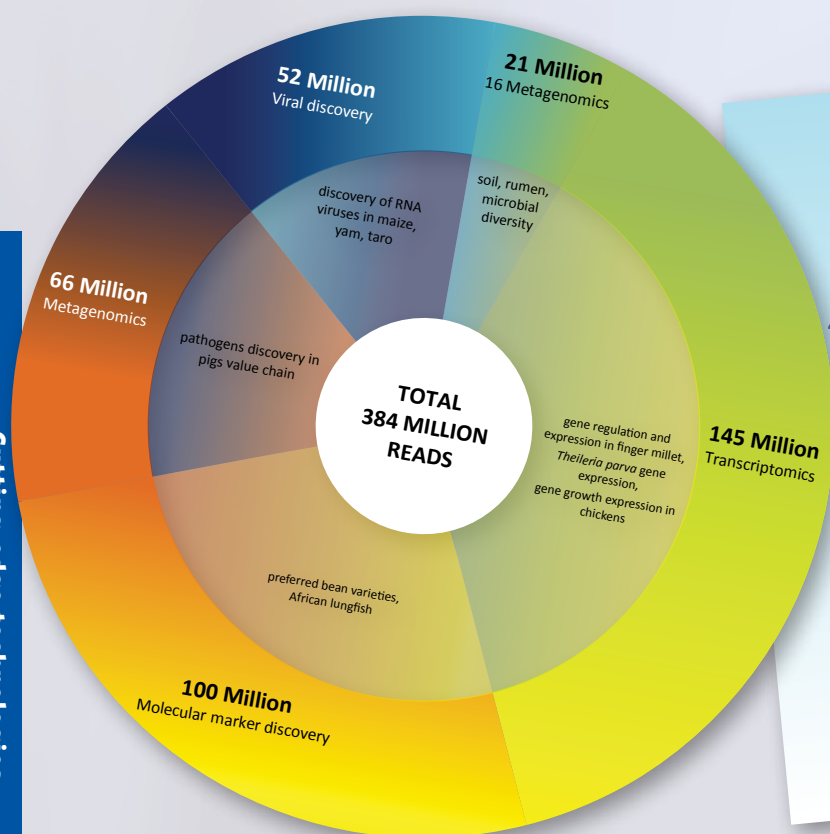
The ability to generate terabytes of genome sequencing data, has enabled the BecA-ILRI

Hub to contribute to key information on the epidemiology of MLND in eastern and central Africa; provide support for marker-assisted crop breeding across Africa; and provide indepth gene expression analysis of finger millet and other African orphan crops and livestock.

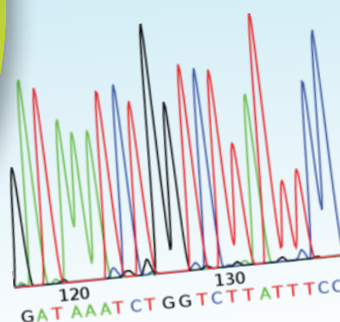
Furthermore, NARS partners have begun to leverage the superior genomics capacities at the BecA-ILRI Hub to strengthen their research programs e.g. research on the sweetpotato at Gulu University (Uganda) funded by BMGF through a Program for Emerging Agricultural Research Leaders (PEARLs) grant, and cassava research funded by BMGF and DFID at the Mikocheni Agricultural Research Institute (MARI) in Tanzania.

left: Genomics data generated on the Illumina MiSeq platform

right: Genotyping services provided on the genetic analyser



58799
DNA fragment analysis
(SSR based genotyping
of crops and livestock)



1348
Reactions of low
throughput sequencing
(Crop, livestock and
microorganism)

Technology transfer for accelerated crop improvement

Through an alliance with the John Innes Centre (JIC), UK, the BecA-ILRI Hub is focusing on accelerating crop improvement in Africa by transferring technologies from the JIC to the BecA-ILRI Hub*.

The Golden Gate Platform established at the BecA-ILRI Hub in May 2015 is providing support to regional scientists in developing rapid and efficient strategies for plant transformation. This method is enabling scientists to reduce the time for development of DNA constructs, which are used in transferring genes with desirable traits to plants, from a number of years to a matter of days.

Scientists using the new technology platform are drawn from international research institutes including the International Institute of Tropical

Agriculture (IITA), CIP and the BecA-ILRI Hub; and national research institutes and universities including Kenyatta University, JKUAT, KALRO, KEPHIS, Uganda's National Agricultural Research Organization (NARO), Uganda Christian University, Tanzania's Agricultural Research Institute, MARI, Nigeria's National Root Crops Research Institute, Zimbabwe Agri Biotech and University of Zimbabwe.

The facilities available include a core set of DNA constructs freely accessible to users; access to essential supporting platforms established by the BMGF-funded project, Engineering Nitrogen Symbiosis for Africa (ENSA); and a management tool website used by the BecA-ILRI Hub. Experts from JIC and a larger global network, the Cereal Engineering Consortium, are contributing to making the BecA-ILRI Hub a centre of excellence for synthetic biology in eastern and central Africa.

**Read more about the BecA-JIC alliance on page 26*

Jacqueline Muteti, IITA research associate working at the BecA-ILRI Hub



INTERNATIONAL RESEARCH CENTRES

at the BecA-ILRI Hub

Building capacity for food safety and nutrition analysis

By **Tawanda Muzhingi**, nutritional biochemist, International Potato Center;
Head of the Food and Nutritional Evaluation Laboratory

With support from the Australian government, CIP established a Food and Nutritional Evaluation Laboratory (FANEL) within the nutrition platform at the BecA-ILRI Hub to facilitate a range of analyses on sweet potato and orange-fleshed sweet potato (OFSP)—derived food products in Kenya.

Regional capability in high-quality food chemistry and nutritional analysis is critical to the development of OFSP for nutritional

improvement in sub-Saharan Africa. The analysis being conducted at the BecA-ILRI Hub will enable CIP to improve the management of factors affecting pro-vitamin A concentrations in improved sweet potato varieties, including cultivar differences; effects of production practices; growing location; harvest maturity; and post-harvest handling and processing. The carotenoid analysis procedures conducted at the FANEL are being validated by established labs in the USA and UK.

Daniel Mbogo, CIP research associate, works at FANEL at the BecA-ILRI Hub





Sweetpotato farmer in Kenya

‘The role of FANEL is to generate evidence on the nutritional superiority and safety of crops and food products,’ says Tawanda Muzhingi, a food scientist with expertise in food analysis and food product development. ‘Through this platform, scientists from CIP are contributing to addressing food and nutritional security in Africa and beyond.’

Muzhingi is assisted by research associate Daniel Mbogo who specializes in food science, food microbiology and biotechnology; and research assistant Derick Malavi, a specialist in food microbiology. In addition to biochemical analysis, the CIP team at the BecA-ILRI Hub is involved in building the capacity of students and partners from the private sector and national agricultural research programs to conduct various nutritional and food safety analyses.

The nutrition platform is now equipped with advanced state-of-the-art equipment for

analysing fat soluble vitamins, antioxidants, minerals, and proximate analysis of food crops and food products of interest to CIP programs, CGIAR Research Program on Roots, Tuber and Banana, Agriculture for Nutrition and Health and other international and national research programs. The platform also has the capacity to determine the safety of food crops and food products through food microbiology evaluation.

Current CIP activities in the nutrition lab are financed through the BMGF-funded Sweetpotato Action for Security and Health in Africa Phase 2 and the Scaling up Sweetpotato through Agriculture and Nutrition program which is funded by the DFID. The FANEL facility has also supported analysis for partner organizations such as HarvestPlus and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and is looking forward to working as a service and reference laboratory for the region.



Anne Muiruri, APTECA program coordinator at the BecA-ILRI Hub

Providing safe maize for Africa: The Aflatoxin Proficiency Testing and Control in Africa project

By **Tim Herrman**, Texas state chemist, Texas A&M AgriLife

The Aflatoxin Proficiency Testing and Control in Africa (APTECA) program is hosted by the mycotoxin diagnostics platform at the BecA-ILRI Hub. The program, managed by the Texas A&M University, USA, was initiated to support the commercial maize milling sector in Kenya through a public-private partnership.

Cereal millers which participate in the voluntary program manage aflatoxin risk by improving their quality systems to accurately perform their own tests for aflatoxins in maize flour.

PROFICIENCY TESTING PROGRAM

Participation in the APTECA program improves testing accuracy through qualification of the mill's laboratory analysts; use of working controls with a known level of aflatoxin; routine proficiency testing; and verification of mill results by the ISO accredited Texas A&M AgriLife laboratory housed at the BecA-ILRI Hub.

In 2015, 31 laboratory analysts from commercial mills across Kenya attended training and qualified to analyse maize flour using validated aflatoxin

testing platforms. These qualified individuals analyse working control samples twice a week at their respective mills to ensure testing accuracy and results are evaluated using a statistical process control charting technique. Further verification of mills' aflatoxin test results of finished product occurs at the Texas A&M AgriLife laboratory at the BecA-ILRI Hub and results are sent to the APTECA mills to assist in quality improvement and aflatoxin risk management.

Already, APTECA has hosted five proficiency testing exercises involving 30 industry and public sector laboratories. The companies involved in the project include Osho Grain Millers; Unga Holdings; Alpha Mills; Capwell Industries; Kabansora Millers; Kenblest Group; Maisha Flour Mills; Mombasa Maize Millers; Pembe Flour Mills; Premier Group; and United Millers all from Kenya.

Co-regulation

The APTECA research is part of an effort to explore co-regulation of aflatoxin as a regulatory risk-management policy alternative with the aim of improving food safety and facilitating trade

in Africa. Co-regulation involves a government-private sector partnership in regulation that includes statutory or government-backed codes of practice combined with regulatory and industry oversight. A marketing study conducted by the International Food Policy Research Institute (IFPRI) and the Western Michigan University in collaboration with Texas A&M AgriLife explored the impact on sales of marketing products branded with a logo on packages of maize meal stating 'Aflatoxin Tested Process Verified by APTECA.' This logo conforms to the East African Community labelling requirements and AgriLife has received trademark approval for it from the Kenya Intellectual Property Institute.

A memorandum of understanding (MoU) with a Kenya regulatory authority, accreditation of the AgriLife laboratory activities by the Kenya Accreditation Service, and training regulatory chemists from six countries and nine agencies has helped lay the groundwork for a regional public-private sector partnership to manage aflatoxin risk and facilitate trade among countries in the Common Market for Eastern and Southern Africa.

Members of the Kenyan Cereal Millers Association visit the BecA-ILRI Hub



NURTURING PARTNERSHIPS

at the BecA-ILRI Hub

Sweden's continued support for biosciences innovation in Africa

In August 2015, the BecA-ILRI Hub staff and the ABCF fellows held a celebration in honour of Gity Behravan, first secretary, regional research cooperation, at the Embassy of Sweden in Kenya. Through her oversight role in the BecA-ILRI Hub-Sweden partnership, Behravan has been instrumental in the growth of the BecA-ILRI Hub's capacity to empower African scientists and NARS to solve Africa's agricultural challenges by strengthening research for development capacity in biosciences. Behravan expressed her satisfaction of the relevance of the BecA-ILRI Hub to the wider African science agenda and pledged her continued support saying 'I am not leaving you behind, but will continue to support this program in my new role in Stockholm.'

below: from the left, Philip Chiverton (Sida), Appolinaire Djikeng (BecA-ILRI Hub) and Erik Bongcam-Rudloff (Swedish University of Agricultural Sciences (SLU) outside Sida office in Stockholm, 30 June 2015

right: Gity Behravan (second row, sixth from the left) with BecA-ILRI Hub staff and ABCF fellows



On June 30, BecA-ILRI Hub director visited SLU in Uppsala and the Sida in Stockholm to discuss Sweden's continued role in enhancing agricultural productivity in Africa. The deliberations during the meetings focused on emerging areas of collaboration in the BecA-Sweden partnership, including possibilities for joint resource mobilization and implementation of collaborative programs with SLU, Sida and other Swedish partners.

'I am not leaving you behind, but will continue to support this program in my new role in Stockholm.'

Gity Behravan, Embassy of Sweden, Nairobi, Kenya



Taking up the partnership's oversight role from Behravan is Claes Kjellström, senior policy specialist in the Swedish International Development Cooperation Agency (Sida) department for Africa. Kjellström's visit in November demonstrated Sweden's continued support of the BecA-ILRI Hub's role in the increased use of agricultural biotechnology as one of the means of achieving food and nutritional security in sub-Saharan Africa.

Kjellström noted that the BecA-ILRI Hub's approach to research for development is consistent with the Swedish government's strategy of creating

synergies between research across different programs as well as with other development investments. He concurred with his predecessor's assessment of the BecA-ILRI Hub's achievement in the partnership as having an excellent performance and attaining all objectives with very few risks.

The strong financial support from the Swedish government builds on a robust scientific base that the BecA-ILRI Hub has maintained with Swedish academic and research institutes including the SLU, the Swedish National Veterinary Institute (SVA), Stockholm Environment Institute (SEI) and Chalmers University of Technology.

Partnering with Uganda to enhance bioscience applications for inclusive agricultural growth

As part of its efforts to remain well informed of regional agricultural research for development priorities, the BecA-ILRI Hub has signed MoUs with various strategic regional institutions. An MoU signed in 2014 with the Uganda National Council for Science and Technology (UNCST) enabled the six-month secondment of Julius Ecuru, assistant executive secretary at UNCST to the BecA-ILRI Hub as policy and strategy advisor. During his secondment, Ecuru spearheaded the development of the BecA-ILRI Hub Strategic and Operational Plan 2015-2018.

In September, a high-level BecA-ILRI Hub-Uganda country strategy symposium convened by UNCST at their headquarters in Kampala explored opportunities for regional collaboration

in bioscience research and capacity building. During the deliberations on how Uganda NARS actors can maximize opportunities available at the BecA-ILRI Hub, the director Appolinaire Djikeng emphasized that the BecA-ILRI Hub should be seen as an extension of the capabilities available within the NARS.

UNCST board chairperson Theresa Sengooba, who is a member of the BecA-ILRI Hub advisory panel, commended the BecA-ILRI Hub for its support to NARS in the region. As of 2015, the BecA-ILRI Hub has provided support to Ugandan agricultural research institutions and universities totalling over USD 725,000.

At the September BecA-UNCST symposium,

As part of its efforts to remain well informed of regional agricultural research for development priorities, the BecA-ILRI Hub has signed MoUs with various strategic regional institutions.

Ugandan banana farmer prepares produce for export





alumni of the ABCF fellowship program shared their experiences of how the BecA-ILRI Hub contributes to bioscience and innovation capacity building. They included Charles Masembe, an associate professor at Makerere University, who is involved in research on African swine fever; Laban Turyagyenda, the director of the Ngeta Zonal Agricultural Research and Development Institute who is researching drought- and disease-tolerant cassava varieties; and Alex Bombom, a post-doctoral scientist at the BecA-ILRI Hub, who shared his seminal work on the development of a hybrid crop between maize and sorghum, with high potential for dual-purpose use as both food and fuel crop.

Among the opportunities for the BecA-ILRI Hub's continued nurturing of the next generation of scientists highlighted was the expansion of the faculty at the BecA-ILRI Hub to include more representation from Uganda. BecA-ILRI

Hub faculty comprising key scientists from institutions within Africa and around the globe provides scientific support across various fields, enabling a broader and deeper range of research and capacity strengthening programs and facilitating the mentoring of a larger number of young African scientists.

The extended BecA-ILRI Hub faculty comprising key scientists from institutions within Africa and around the globe provides scientific support across various fields



Millet farmer in Kenya

Joining forces with ICRISAT Nairobi to develop improved finger millet varieties

By **Damaris Odeny**, biotechnology scientist, International Crops Research Institute for the Semi-Arid Tropics

Finger millet is a highly nutritious grain with incredible grain storage quality and is used in many African countries to fight malnutrition. Although widely grown in the drylands due to its exceptional ability to withstand drought, finger millet is also suited for production in cooler environments. It is an excellent source of fodder for livestock, has superior malting quality and is currently gaining popularity among smallholder farmers for its commercial potential. In many parts of Africa, demand for finger millet outstrips supply and therefore the grain fetches very attractive prices in local markets. Despite its demonstrated importance, breeding of finger millet has lagged behind, mainly due to its small

flowers that limit targeted breeding, and the laborious nature of its production.

But recent research input from the BecA-ILRI Hub, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Nairobi and key national programs at Maseno University, Kenya; Makerere University, Uganda; MARI, Tanzania; and Addis Ababa University, Ethiopia is likely to change the future production of finger millet in the region.

Funded through the Bio-Resources Innovations Network for Eastern Africa Development (Bio-Innovate) program, led by ICRISAT-Nairobi and

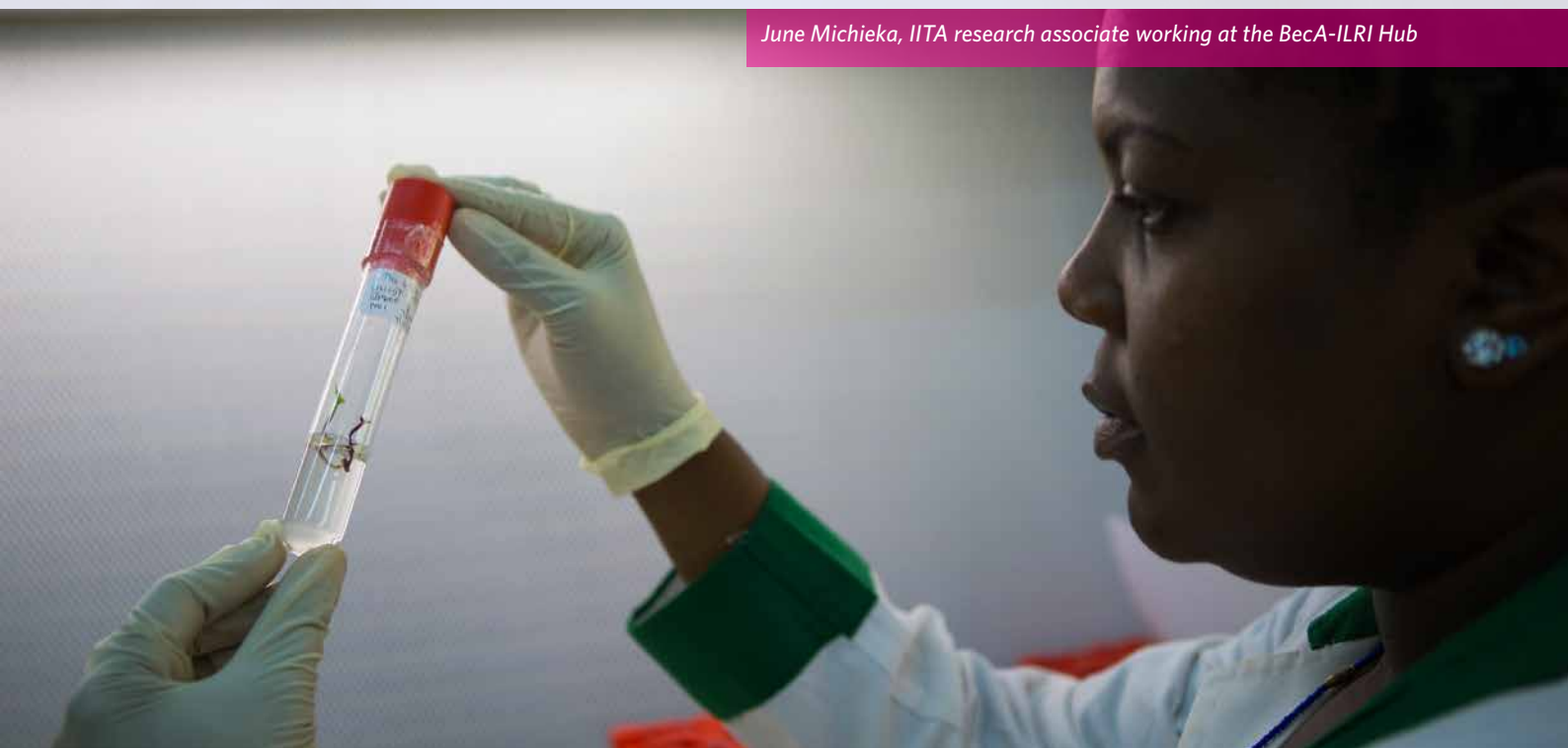
utilizing the advanced genomics facility and expertise at the BecA-ILRI Hub, the project's aim is to produce a whole genome of finger millet, a product that would provide a snapshot of important genes and how they can be better targeted for faster release of improved varieties. In this collaborative project, ICRISAT Nairobi has been providing finger millet germplasm and breeding expertise, as well as tapping into the already established working relationship between the World Agroforestry Centre and the African Orphan Crops Consortium, to generate genomic sequences from the Beijing Genomics Institute in China. ICRISAT, which has a mandate to carry out research on dryland cereals and legumes, holds in trust more than 700 global collections of finger millet. The finger millet variety KNE796 has been selected as the reference genotype for this ongoing project due to its resistance to blast disease and ICRISAT's long history of breeding the variety.

The BecA-ILRI Hub's advanced genomics facility is central to the success of this project through the provision of advanced computing and a one-of-a-kind regional laboratory facility, and the building of the capacities of national partners at different levels. Breeders from national programs have received training on the use of the newly generated finger millet data in their breeding programs from the BecA-ILRI Hub. Through the

ABCF program, NARS scientists have also received training in finger millet transcriptomics (the study of gene expression pattern of an organism under a particular condition) with a major objective of understanding resistance to Striga and blast disease in finger millet. Striga, also known as witch weed, and blast disease, are the most devastating factors in finger millet production and can each result in 100% yield loss on farmers' fields.

The ongoing collaboration is making a significant contribution to finger millet breeding which has so far been traditional leading to yield from farmers' fields that are less than a third of potential. While it previously took at least seven years of breeding to release an improved finger millet variety, the new genomic tools being developed as part of the project will make it possible to release an improved finger millet variety within five years. The research results will also provide finger millet breeders with a new exciting opportunity to combine the genomic data with field data and precisely identify genes that should be targeted for increased production.

It is our hope that the low yields experienced in the past as a result of low research priority, difficulty in management during cultivation due to diseases such as blast and weeds such as Striga, and the lack of improved varieties for planting will be a thing of the past as we modernize finger millet breeding in the region.





Visiting scientist Alemu Abate Asfaw from Aksum University, Ethiopia working at the BecA-ILRI Hub

The BecA-ILRI Hub-John Innes Centre alliance updates

The first year of the formal alliance between BecA-ILRI Hub and JIC has seen the implementation of many activities. Already, there has been considerable mobility of resources and researchers at all levels between the two institutes.

LEVERAGING ADVANCED SKILLS TO DRIVE RESEARCH

As a demonstration of commitment in supporting this alliance, the JIC has posted a full-time researcher, Tilly Eldridge, at the BecA-ILRI Hub. She supports the genomics platform specifically on the use of next-generation sequencing to identify molecular markers for breeding. This work has been made possible by ongoing support of JIC wheat geneticist, Cristobal Uauy.

Ethiopian plant breeder Alemu Abate received support from JIC senior PhD student, Peter Emmrich in establishing toxin levels in grass pea, a drought-resistant crop. Grass pea is a key food security crop in marginal areas. It is highly tolerant to drought, high-yielding, rich in protein, can fix Nitrogen and grows with minimal inputs. But grass pea grains produce a toxin known as beta-ODAP that causes irreversible leg muscle paralysis in humans if consumed as a main food for more than three months. Abate who is a lecturer at Aksum University, Ethiopia and is currently undertaking a PhD at Haramaya University, Ethiopia, is screening grass pea collections to identify low toxin varieties that will facilitate the full exploitation of this

nutritious crop. During a two-month stay at the BecA-ILRI Hub, Emmrich introduced a technique for measuring ODAP concentration in plants and supported the analysis of samples.

SUPPORTING PARTNERS' SKILL ENHANCEMENT AND TRAINING

Following the transfer of the Golden Gate synthetic biology platform from JIC to the BecA-ILRI Hub in May 2015, two associated training workshops were held: one for BecA-ILRI Hub staff and scientists from Kenyatta University and CGIAR centres including CIP and IITA and their partners; and a second one for NARS partners. A member of the BecA-ILRI Hub team, Pauline Asami, also spent four weeks at JIC to acquire

additional skills on the operations of the platform.

A graduate student partnering scheme was launched to increase the effectiveness of early career scientists and form lasting relationships between researchers from the JIC and Africa. The Agricultural Scientists Support Exchange Team (ASSET) is a peer-based network centred on soft skill development. The first ASSET training took place in Kigali, Rwanda in November with 16 participants undergoing a leadership and management course. The training gave them an opportunity to practice key soft skills including communication, coaching/mentorship, and goal orientation. These skills will be practiced through facilitated rounds of peer review exchange.

The collaborative activities in the BecA-ILRI Hub-JIC alliance were made possible through funding from the John Innes Foundation and the BMGF-funded ENSA project.



In May 2015, a team of scientists from JIC visited the BecA-ILRI Hub to conduct a workshop that saw the transfer of the Golden Gate cloning technology from JIC to the Hub. The team included ENSA scientific project manager Christian Rogers; research assistant, Andy Breakspear; and post-doctoral scientist, Jodi Lilley. In addition the JIC director of international strategy and liaison, Chris Darby; and plant scientist, project leader and ENSA project coordinator, Giles Oldroyd visited the BecA-ILRI Hub to advance the strategy for the BecA-JIC alliance.

front row: (left to right) Josephine Birungi, BecA-ILRI Hub; Tilly Eldridge and Jodi Lilley, JIC; Appolinaire Djikeng, BecA-ILRI Hub; and Giles Oldroyd, JIC

back row: (left to right) Chris Darby, JIC; Sita Ghimire, BecA-ILRI Hub; Andy Breakspear, JIC; and Jagger Harvey, BecA-ILRI Hub

Empowering African institutions to harness bioscience innovations

In keeping the commitment to support the harnessing of biosciences innovations for regional impact, the BecA-ILRI Hub held strategic planning meetings with various NARS to map out strategies for short-, medium- and long-term engagements to address identified skills gaps.

Ethiopia Institute of Agricultural Research

Priority areas identified included:

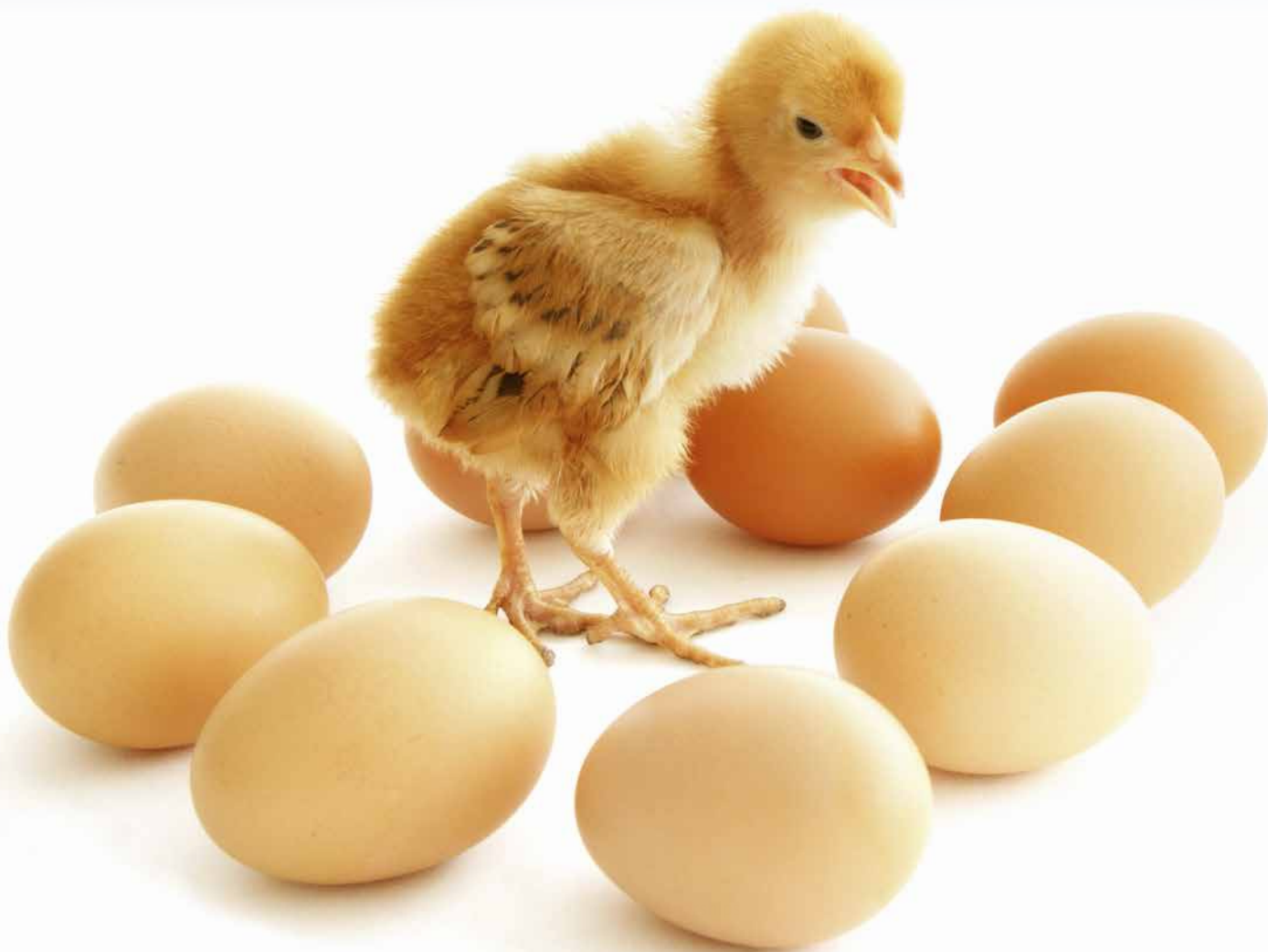
- **Crops:** Breeding programs of five target crops—maize, sorghum, wheat, common beans and chickpeas—were identified for modernization. Other crops of importance to Ethiopia considered potential candidates for this initiative were tef and enset.

- **Livestock:** The partnership established poultry and large livestock species as the research focus, linked to ongoing ILRI programs.
- **Microbial studies:** Research areas highlighted in this area include studies on diversity, beneficiary microbes and applications (bio-fertilizers, bio-pesticides, etc.).

Rwanda Agriculture Board

Priority areas identified included:

- **Livestock:** Disease diagnostics and characterization of animal genetic resources
- **Crops:** Molecular breeding, disease diagnostics and forage germplasm and development
- **Capacity building** through the ABCF program.



Uganda National Crops Resources Research Institute

Priority areas identified for Uganda included:

- **Crops:** Molecular breeding of diverse crops
- **Capacity building:** Lab management and equipment maintenance; genomics and bioinformatics; BMS training and adoption.
- **Technologies:** Plant transformation; genome profiling and informatics; nutrition profiling; and the use of the IGSS platform.

West Africa region

In response to the growing demand for greater support of bioscience capacity in West Africa, discussions were held with key research institutions in the region—Centre d'étude Régional pour l'Amélioration de l'Adaptation à la Sécheresse (CERAAS) and L'Institut de Technologie Alimentaire (ITA) in Senegal; and the WACCI in Ghana. Priorities identified for West Africa included:

- **Training** in bioinformatics, genomics and metagenomics and molecular breeding as a key need by CERAAS
- **Collaborative research on mycotoxins** and training opportunities under the ABCF were singled out by ITA
- The **placement** at the BecA-ILRI Hub of students funded under the World Bank African Centres of Excellence grant; **summer internships** for both PhD and MSc students; **support in data analysis** for molecular marker studies; **capacity strengthening in publishing and scientific writing** and PhD research proposal development; and staff exchanges were identified as priorities by WACCI.

Based on the strategic engagements in 2015, it was agreed that joint activities would commence in 2016, further strengthening the role of BecA-ILRI Hub as an extension of the expertise accessible with the NARS.

Surviving the tides of change

Over the years, an Australian government-funded partnership between the BecA-ILRI Hub and the CSIRO successfully implemented a portfolio of projects in priority research areas aimed at improving food and nutritional security and animal health, with related capacity building activities.

Owing to Australian aid policy changes and the ensuing decision not to fully fund a third phase of the BecA-ILRI Hub-CSIRO partnership, the Australian Department of Foreign Affairs and

Trade (DFAT) provided AUD 3,000,000 as 'core program support' to the partnership. This support is enabling the partnership to gain maximum value from the outcomes of the previous phase and supporting the continuation of broader links between the BecA-ILRI Hub and Australia.

A new partnership under development is a collaboration with the Queensland University of Technology to enhance crop improvement research through nutrigenomics biotechnology transformation.

STRENGTHENING SCIENCE LEADERSHIP IN AFRICA

Empowering African institutions to harness bioscience innovations

The BecA-ILRI Hub's ABCF program continues to be a cornerstone for capacity building in the area of agricultural biosciences not only in eastern and central Africa, but also in the continent as a whole. In 2015, BecA-ILRI Hub hosted 79 visiting scientists from 16 countries. Key to realizing the capacity building program achievements have been partnerships with institutions with shared research and development interests.

The African Women in Agricultural Research and Development (AWARD) played a pivotal role in strengthening women's participation by co-sponsoring three women scientists; two from Kenya and one from Nigeria. The International

Foundation for Science through its grant program for individual scientists co-supported four scientists from Cameroon, Democratic Republic of Congo, Kenya and Tanzania. For the first time since its inception in 2010, the ABCF fellowship program hosted research scientists from Equatorial Guinea and Gabon.

In addition to the fully supported ABCF research fellows, the BecA-ILRI Hub hosted three self-sponsored scientists: a Kenyan sponsored by KALRO; an Ethiopian sponsored by the Vavilov-Frankel Fellowship through Bioversity International; and another Kenyan sponsored by the ILRI Forage Diversity program.

The African Women in Agricultural Research and Development (AWARD) played a pivotal role in strengthening women's participation by co-sponsoring three women scientists

'The fellowship at the BecA-ILRI Hub provided me with an opportunity to learn new techniques in molecular work and bioinformatics, as well as to share the knowledge I have on fungi and microbiological techniques with others. It was an eye-opener to other approaches in research in the field of taxonomy of fungi, in particular aflatoxin-producing fungi.

The well-equipped laboratories, available supplies and qualified staff ensured smooth running of experiments within a short period of time, which would otherwise have meant exporting samples to laboratories abroad. I will definitely transfer the skills I acquired to postgraduate students at my home institution.'

Professor Sheila Okoth, UoN

Growing the BecA-ILRI Hub faculty

The ABCF program continued to benefit from the expertise and experience of senior scientists from the NARS. Sheila Okoth from UoN spent nine months at BecA-ILRI Hub conducting research on mycotoxins. During her tenure, she mentored over five upcoming scientists and significantly contributed to strengthening the mycotoxin diagnostics platform at the BecA-ILRI Hub. A distinguished professor at the School of Biological and Physical Sciences at the UoN and an AWARD alumnus, Okoth is now part of the BecA-ILRI Hub's extended faculty.

31



Through the **ABCF program**, the BecA-ILRI Hub supports and strengthens capacity of African NARS to drive innovation for impact:

89%

of BecA countries represented in the ABCF fellowship program

79

Research scientists from African NARS hosted at the BecA-ILRI Hub under ABCF fellowship to conduct research responding to priority national agricultural challenges

20

Regional and international meetings where ABCF alumni presented research findings

04

ABCF alumni research sub-networks in livestock and crop improvement under development

03

NARS laboratories equipped and human capacity strengthened through training

397

African NARS researchers trained through short skill-enhancement courses

14

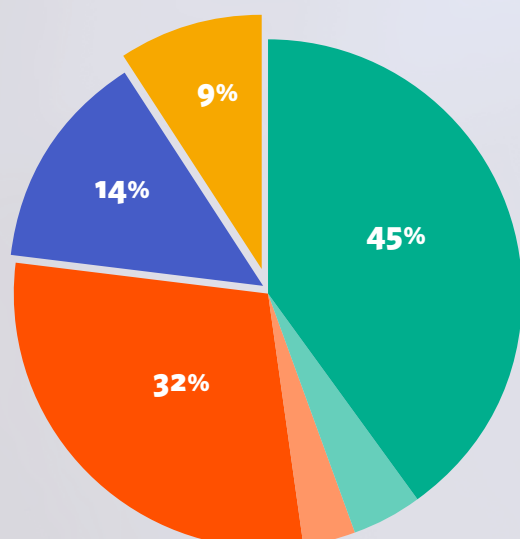
Strategic meetings attended by BecA-ILRI Hub staff for scoping high-value opportunities for partnership to support capacity building and research

01

New country (Equatorial Guinea) included among those participating in the ABCF fellowship program

01

New course (animal quantitative genetics and genomics) added to the ABCF portfolio of training courses



Contribution of ABCF research to agricultural development priorities in Africa

- Food safety and nutrition
- Climate change
- Livestock
- Crops and livestock research included 22 projects on neglected species
- Crops

Revitalized strategy for engagement with African NARS


Owing to the success of concerted and intentional support from the BecA-ILRI Hub in mobilizing bioscience for agricultural development in Africa, some countries have begun to emerge as front runners in agricultural bioscience.

Consequently, the BecA-ILRI Hub established an approach designed to consolidate and build on these promising outcomes. Focus countries have been categorized into two blocks referred to as stage one and stage two countries. Currently, stage two countries, which represent those in which the BecA-ILRI Hub has had significant investment in the last five years, complemented by significant investment from their NARS, include Cameroon, Ethiopia, Kenya, Rwanda, Tanzania and Uganda. To nurture greater engagement with stage one countries, the

BecA-ILRI Hub continues to offer placements and training opportunities to researchers on the basis of individual applications.

To enhance engagement with NARS in prioritizing their research agenda, stage two countries will be expected to play the key role of identifying individuals who are active and strategically placed to strengthen national systems by transferring skills acquired through the ABCF fellowship program. It is anticipated that over time, more countries will be classified as stage two. With this approach, heads of institutions from identified NARS will nominate scientists for selection and support to conduct research at the BecA-ILRI Hub, ensuring that this research further builds on and contributes to previously funded and continuing research in identified areas. Participants in the BecA-ILRI Hub annual workshops will also be identified through a nomination process. This strategic direction is already reflected in the call for applications for the 2016 intake of ABCF research fellows.

Intensified engagements with regional governments have also been initiated with national councils for science and technology (NCSTs). The discussions are exploring funding opportunities within the Kenyan and Ugandan NCSTs to support research fellows at BecA-ILRI Hub and return-to-home country grants for fellows who have completed their placement.



*Roger Pelle, BecA-ILRI Hub
working with visiting scientist
Sebastian Mengomo from
Agro-Forestry Training School
of Bata Littoral, Equatorial
Guinea*

Broadening support capacity through extended faculty

In addition to the existing four annual training workshops, the BecA-ILRI Hub introduced the 'Animal quantitative genetics and genomics training workshop'. This new annual workshop ran from 1-5 June 2015 and drew 18 participants from 11 African countries. The demand for this training arose from the need to strengthen the capacity of early career scientists from the NARS, mainly in carrying out statistical genetics to support livestock breeding.

Additionally, partnerships with collaborating institutions have afforded access to specialized training for both the NARS partners and the BecA-ILRI Hub staff. A genome-wide association studies training was conducted in collaboration with ICRISAT.



SAMUEL AGGREY is a professor in the Department of Poultry Science at the University of Georgia. His expertise is in the area of population and quantitative genetics, bioinformatics and nutrigenomics. His research focuses on application of statistical models to traits of economic importance in poultry, genotype-nutrition interactions, quantitative and molecular basis for feed utilization efficiency, and nutrigenomics of sulphur amino acids. He is also a faculty member of the Institute of Bioinformatics at the University of Georgia.

Profile of the trainers for the animal quantitative genetics and genomics training workshop



ROMDHANE REKAYA is a professor of animal breeding and genetics at the Department of Animal and Dairy Science at the University of Georgia. His expertise is in the area of theoretical quantitative genetics, statistical genomics and bioinformatics. His research focuses on the development of statistical and bioinformatics tools for genome-wide association studies and genomic selection. He is also faculty member at the Department of Statistics and the Institute of Bioinformatics at the same university.



RAPHAEL MRODE is a principal scientist in quantitative genetics at the International Livestock Research Institute. He holds a joint position at the Scotland Rural College as senior research scientist and a reader in quantitative genetics. His expertise is in the area of quantitative genetics and genomics. His research interest is in the development and application of statistical methods and linear models for national and international genetic evaluations, genomic selection and modelling of novel traits in dairy cattle.

Supporting the USA National Institutes of Health grantees in Africa

In addition to the annual training workshops and the multi-institutional trainings conducted in 2015, the BecA-ILRI Hub team delivered customized training responding to specific demands from national research programs.

From 17–28 August 2015, the BecA-ILRI Hub team conducted training in molecular biology, genomics and bioinformatics supporting a team of eight researchers from Addis Ababa University, Ethiopia. The group are a part of the team implementing the 'Systems biology for molecular analysis of tuberculosis in Ethiopia' project in collaboration with the J. Craig Venter Institute,

USA. Funding for the two-week course was part of a grant from the National Institutes of Health, USA, for their research on tuberculosis.

Another tailor-made training was delivered to the KEPHIS, from 4–6 November 2015, involving four staff. The training focused on topics such as the application of molecular markers and the application of micro-satellites in plant genetic research and principles of sequencing.

The BecA-ILRI Hub will leverage this model of capacity building to ensure it is continuously and innovatively responding to regional needs.

'When our collaborator Rembert Pieper from the J. Craig Venter Institute in USA proposed the BecA-ILRI Hub as a training site, I was excited because it meant we could have more people trained. The option of travelling to USA for the same training would have cost the project too much time and money.'

Professor Gobena Ameni (standing, 3rd from the left), team leader and principal investigator 'Systems biology for molecular analysis of tuberculosis in Ethiopia'



Catalysing sustainable growth in biosciences research capacity

Technical assistance from the BecA-ILRI Hub—including support in laboratory design and management, equipment installation, commissioning and training of engineers; securing funding for capacity building activities; and connections to networks and key influencers (e.g., suppliers of reagents and equipment)—is strengthening the bioscience capabilities of NARS. Institutions that have been supported now have enhanced research and capacity building activities and/or have secured funds to increase their bioscience capabilities. These include:

GULU UNIVERSITY, UGANDA

The BecA-ILRI Hub's engagement with Gulu University began in 2009 with support for the development of a proposal for funding from the UNCST Millennium Science Initiative. The proposal on 'The use of molecular diagnostic methods in the study of trypanosome infections in post-conflict districts of Amuru, Adjumani and

Moyo, northern Uganda' was successfully funded; and BecA-ILRI Hub was one of the collaborators. An MoU was signed between the BecA-ILRI Hub and the university to establish a long-term research and capacity building relationship.

Gulu's Faculty of Science dean Richard Echodu, then a PhD student, was assigned the role of overseeing the establishment of the molecular diagnostics laboratory. The BecA-ILRI Hub has since provided support in laboratory design, equipment installation and commissioning.

Gulu University staff and students have participated in annual workshops and additional research and equipment grants have been secured with the BecA-ILRI Hub's support. In a PEARLs grant for disease management and production of virus-free planting materials for the sweet potato led by Echodu, the BecA-ILRI Hub provides high-end bioscience applications support, while



Installation of laboratory equipment coupled with training of laboratory technicians at Gulu University by James Ndegwa from ILRI Technical Services Unit (left)

Growing science leaders: Alumni profile

JEROME DINGA

ABCF alumnus Jerome Dinga was awarded a grant by the International Society of Infectious Diseases (ISID) to further his research into finding safe and affordable vaccines against malaria and East Coast fever. Dinga, who received the ISID grant in 2015, had earlier defended his PhD in Biochemistry at the University of Buea, Cameroon, part of which was carried out in part at the BecA-ILRI Hub.

Malaria and East Coast fever are significant human and livestock health challenges in Africa, respectively. In 2015, 89% of malaria cases and 91% of malaria deaths occurred in sub-Saharan Africa and there are currently no licensed vaccines against malaria. East Coast fever is an acute disease of cattle and is usually characterized by high fever, swelling of the lymph

the rest of the work is conducted in the Gulu University molecular laboratory.

Gulu University now provides research mentorship and training for MSc and PhD students, hosts international students and has increased collaboration with international advanced research institutions.

ACQUISITION OF EQUIPMENT FOR REGIONAL FACILITIES

Funding from a Sida supplementary grant enabled the acquisition of molecular biology equipment in support of the RAB Rubona station, Rwanda; the NMAIST, Arusha, Tanzania; and the University of Dschang, Cameroon.

The three institutions received basic molecular biology equipment along with equipment installation, commissioning and training of engineers and users. To ensure effective management of the laboratories, relevant staff

nodes, difficulty in breathing and high mortality. This livestock disease is found in 11 eastern and southern African countries and is widely regarded as the most serious animal health constraint to increasing the productivity of cattle in the region.

Dinga who is a senior lecturer of biochemistry strongly believes that the understanding of the evolutionary closeness between *P. falciparum* and *Theileria parva*, which cause malaria and ECF respectively, could unlock the discovery of vaccines for these important human and livestock diseases.

from the institutions participated in the annual principles of Laboratory Management and Equipment Operation training workshops and the Laboratory Equipment and Facilities Maintenance workshop.

Activities at these shared laboratory facilities are enabling the conducting of basic bioscience activities in the countries, allowing the BecA-ILRI Hub to position itself for high-end technologies.

In addition to the three grantees, the BecA-ILRI Hub facilitated the installation and commissioning of equipment from Holetta Biotechnology Centre. The laboratory in Ethiopia had earlier been supported in the installation, commissioning and training of staff during the BecA-ILRI Hub's annual LMEO workshop in 2013. In 2015, two ILRI engineers were directly supported by EIAR, underscoring the importance of this assistance to the institution.



Supporting African women in science

In June 2015 the BecA-ILRI Hub team and ABCF fraternity celebrated the birth of **Rayan Beca Babiker**. Baby Beca, the first child of ABCF fellow Rasha Adam from Sudan and her husband Babiker Mohammed, is testament to the significance that the BecA-ILRI Hub places on supporting women in agricultural research.

Adam, a researcher at the Biotechnology and Biosafety Research Centre at the ARC in Khartoum, Sudan joined the BecA-ILRI Hub on 30 June 2014 for a year-long placement. Already expectant when she received her letter of offer to the ABCF program, Adam was not willing to delay her quest to improve the food security situation in Sudan despite being offered a postponement of her placement until after delivery. The BecA-ILRI Hub capacity building team

helped her to develop a work-plan to guarantee her safety and comfort, and she commenced her placement in June 2014 as scheduled.

'I am so grateful to all of you at the BecA-ILRI Hub for the support that you gave me throughout my pregnancy. The ABCF fellows were like family to me, watching over me throughout my pregnancy and showing me how to hold and care for the baby when she arrived,' said Rasha, who gave her baby the name Beca as a reminder of the team that stood by her during this significant period in her career and family life.

Rasha is a true example of the resilience of women in science.

'I am so grateful to all of you at the BecA-ILRI Hub for the support that you gave me throughout my pregnancy. The ABCF fellows were like family to me, watching over me throughout my pregnancy and showing me how to hold and care for the baby when she arrived.'

Rasha Adam holding **Rayan Beca Babiker**



A GROWING TEAM

at the BecA-ILRI Hub

The BecA-ILRI Hub core scientific and technical staff continued to expand to meet the increasing research and capacity building demands. In 2015, the following individuals joined the team:



Helen Altshul, development partnerships specialist, is responsible for identifying, mentoring and managing the performance of adoption partners working in research-for-development teams including private sector, civil society, local government and national agencies. Having worked for international NGOs in various senior management and leadership positions, she brings 20 years' of international experience in both research and development.

Roger Pelle (pictured page 33 left), principal scientist, capacity building, provides technical guidance and strengthens the research capacity of scientists (with a particular focus on molecular parasitology). He previously worked with the ILRI Biosciences vaccine group where he played a key role in developing a new molecular technique (RADES-PCR) to accelerate the rate of identification of important genes and their products in protozoa. His experience spans research and training on the highly pathogenic avian influenza (HPAI) virus and *Theileria parva*. In that regard, he was instrumental in the research

effort that led to the identification of CD8 T cell antigens from *T. parva*, which are now being evaluated as candidate vaccine antigens against East Coast fever and tropical theileriosis.

Tilly Eldridge (pictured page 2 centre), visiting scientist from JIC UK, is the first scientist to be stationed at the BecA-ILRI Hub as part of the BecA-JIC research and capacity building alliance. Eldridge provides support on the genomics platform, specifically with the use of next generation sequencing. She is also responsible for developing relations between the institutes and increasing the contributions of JIC to capacity building at the BecA-ILRI Hub.

Josiah Mutuku, postdoctoral scientist, is conducting studies on molecular plant-pathogen interactions aiming to understand host plant immunity in the bean project. Mutuku has experience in plant-pathogen interactions, including rice-Striga hermonthica interactions; and rice and *Rhizoctonia solani*, the pathogen that causes sheath blight disease.



Samuel Mutiga (pictured page 5), visiting scientist from University of Arkansas and postdoctoral research associate on the rice blast project, is involved in genotypic and phenotypic characterization of the rice blast pathogen populations from USA and from several African countries. His responsibilities include the establishment of a repository of the rice blast pathogen at the BecA-ILRI Hub along with a database which will include genotypic and phenotypic data on the isolates deposited. In addition, he conducts research on various aspects of the gene diversity of the rice blast pathogen.

THE BecA-ILRI Hub INTERNATIONALLY

LOCALLY AND GLOBALLY

High-profile visits

The BecA-ILRI Hub had the privilege of hosting over 500 visitors in 2015 from a cross-section of stakeholders, including government representatives, policymakers, private sector leaders, donors, scientists, journalists and students from across the globe. These visits presented an opportunity to highlight the role of the BecA-ILRI Hub as a key player and strategic partner in demand-driven and responsive agricultural research for food security in Africa, and to increase awareness of technology platforms and research-related services and opportunities within the capacity building program at the BecA-ILRI Hub.

Highlighting the NARS-centred capacity building model at BecA-ILRI Hub

During visits to the BecA-ILRI Hub by representatives of advanced research institutions; policymakers; African NARS; donors; private sector; and capacity building partners, the staff and resident NARS visiting scientists shared highlights of the activities and opportunities available through the ABCF program.

UK chief scientific adviser

A visit by the UK government's chief scientific adviser, Sir Mark Walport to Nairobi in July included a tour of the BecA-ILRI Hub. The visit demonstrated the impact of the UK's investment in research in Africa in the emergence of strategic partnerships between the UK and African countries.

During his visit, Sir Walport met with BecA-ILRI Hub scientists currently involved in components of bean and rice improvement projects supported by the SCPRID program, which is funded by BBSRC, DFID and (through a grant awarded to BBSRC) BMGF, with additional funding from the DBT.

Sir Walport was also appraised of the support provided by the BecA-JIC alliance through the support of resident scientist Tilly Eldridge to Rwandan bean breeder Doreen Mutoni as well as the support from visiting JIC scientist Peter Emmrich to Ethiopian grass pea breeder Alemu Abate, among other capacity building activities.

**Bill & Melinda Gates Foundation
global development chief**

A visit in July by a BMGF delegation led by the foundation's president of global development Chris Elias—and comprising Pamela Anderson, director for agricultural development; Tom Kehoe, deputy director for crops, and agricultural development; Kathleen Walsh the interim director and chief of staff; and Kaci Farrell, program officer for global policy and advocacy—provided the BecA-ILRI Hub with an opportunity to showcase research and capacity building impact that has benefited from the foundation's support.

The delegation was also able to learn more about the plans and implementation of the state-of-the-art facilities for genomics research and genotyping funded by the BMGF through the IGSS project to increase the precision and efficiency of crop and livestock breeding in Africa.

Kenyan policymakers (*pictured right*)

The BecA-ILRI Hub in August hosted a tour of the facilities by Kenyan parliamentarians drawn from various house committees. The members of parliament were on a mission to assess the human and infrastructural capacity for agricultural biotechnology research in Kenya.

The learning visit tour was organized by the National Commission for Science, Technology and Innovation under the Kenya Biotechnology Information Centre's BioAWARE program in collaboration with

the International Service for the Acquisition of Agri-biotech Applications, the Kenya University Biotechnology Consortium and the African Agricultural Technology Foundation.

The policymakers interacted with national and international scientists working at the BecA-ILRI Hub and they ascertained that Kenya has the capacity to carry out advanced biotechnology research through the facilities available in the country.

Building an appetite for Brachiaria grasses

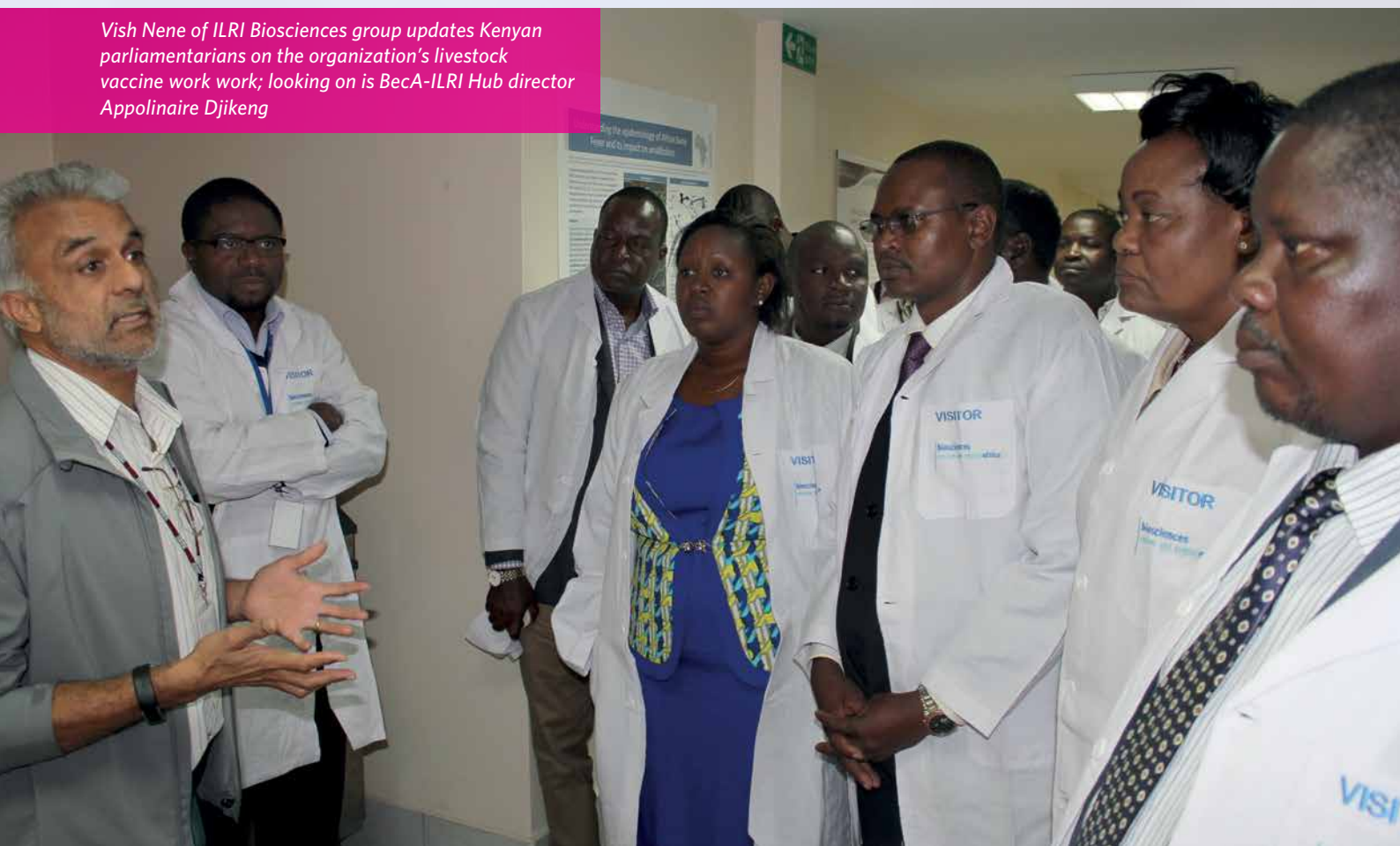
The outstanding on-farm performance of the four Brachiaria varieties under evaluation has received wide media coverage, stimulating considerable interest from farmers and other stakeholders in Brachiaria as a preferred forage option. The BecA-ILRI Hub-led Brachiaria research team is increasingly being regarded as a pacesetter in forage research regionally and has been approached by farmers and development agencies seeking collaboration. As a result, technologies developed in this program are being integrated in other programs to support livestock industries in the region. Additionally, a meeting of forage scientists from eastern and central Africa held

in May 2015 to share the achievements of the Brachiaria program put the BecA-ILRI Hub at the fore in discussions on the priorities in forage research and development in the region.

Making the case for genetic diversity—the IFAD AgTalks

In a highly publicized forum hosted by the **International Fund for Agricultural Development (IFAD)**, Appolinaire Djikeng, the BecA-ILRI Hub director, gave his perspective on a fresh approach to livestock production to help poor and vulnerable farming households in Africa climb up the livestock ladder out of poverty. The talk on 'Lessons from the ugly pig' drew from his personal experiences and highlighted the BecA-ILRI Hub approach in livestock research that emphasizes the utilization of genetic diversity, as well as developing alternative livestock production systems in Africa to provide better opportunities for smallholders. The BecA-ILRI Hub's participation in the IFAD event received extensive social media coverage, raising the awareness of the key themes guiding the research focus, in particular the emphasis on neglected crop and livestock species.

Vish Nene of ILRI Biosciences group updates Kenyan parliamentarians on the organization's livestock vaccine work work; looking on is BecA-ILRI Hub director Appolinaire Djikeng



ENGAGEMENT WITH INVESTORS AND ADVISORY PANEL

Annual Advisory Panel meeting

The second BecA-ILRI Hub Advisory Panel meeting was held in Nairobi from 15–16 April 2015. Members of the panel, African and international biosciences leaders, reiterated their role: as one of providing strategic advice to the ILRI senior management, Board of Trustees and NEPAD—the co-creators of the BecA-ILRI Hub; affording advice on future research directions, new technological developments, potential science and development partners

and resource mobilization opportunities; and creating a forum for deeper interaction among African stakeholders, international institutions, development partners and investors, towards increased use of biosciences in African agriculture.

The meeting discussed the need to ensure affordability of the BecA-ILRI Hub services and products to its NARS clients in relation to the cost of managing the facilities and operations.



EUGENE TERRY

(Advisory panel chair) Senior technical advisor of New Markets Lab



TUMUSIIME RHODA PEACE

Commissioner for Rural Economy and Agriculture at the African Union



THERESA SENGOOBA

Senior advisor to the Program for Biosafety system (PBS), a program hosted by IFPRI



ABDOURAHAMANE SANGARÉ

Manager, Biotechnology and Bio-security Program of the CORAF/WE CARD

The question of the comparative advantage of the BecA-ILRI Hub as a provider of bioscience services vis-à-vis other programs in the region resulted in the recommendation for a landscape assessment of alternative providers of bioscience application support in the region. The survey began in September and a report of the findings will be finalized during 2016.

Donors group meeting

The fourth gathering of BecA-ILRI Hub current and prospective donors was held in Nairobi on 4 June 2015 with representatives from SFSA, the Swedish Embassy, the Australian High Commission, DFAT, BMGF, the Canadian High Commission, the United Nations Educational,

Scientific and Cultural Organization (UNESCO), AGRA, DFID and ILRI.

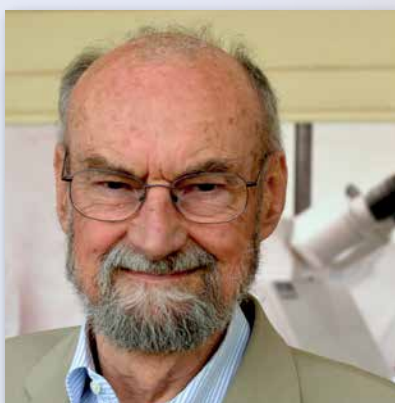
The donor group renewed its commitment to the mission and purpose of the BecA-ILRI Hub and called for: deeper cooperation with NARS; the linking of BecA-ILRI Hub research to national and regional interests and priorities; and new approaches to increase the use of the facilities as strategic priorities.

The donors also expressed their support for the strategic and operational direction of the BecA-ILRI Hub, as stated in the Business Plan 2013-2018 and called for continued documentation of successes and lessons learned to provide data on science and technology in Africa.



AGGREY AMBALI

Advisor and Head of Science, Technology and Innovation at NEPAD Agency



SIR EDWIN SOUTHERN

Founder Chairman and Chief Science Advisor, Oxford, Gene Technology



VISH NENE

Director, Vaccine Biosciences program at ILRI



YEMI AKINBAMIJO

Executive Director at FARA



APPOLINAIRE DJIKENG

*(Advisory Panel Secretary)
Director of the BecA-ILRI Hub*

DONORS IN 2015

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The BecA-ILRI Hub relies largely on funding and grants by its investors. These grants are categorized as:

- 1** Capacity building grants to support ABCF fellows and other visiting scientists, including students.
- 2** Research grants for the BecA-ILRI Hub's thematic research areas.
- 3** Technology and service (infrastructure) grants to ensure the hub maintains its state-of-the-art facilities.
- 4** Grants to support national agricultural research systems to develop new bioscience programs or set-up laboratory infrastructure.
- 5** Income from national, regional and international agricultural research institutes and universities.

The key donors in 2015 included:

- Australian government/DFAT
- BBSRC
- BMGF
- DFID
- SFSA
- Swedish government/Sida
- UNESCO

STAFF IN 2015

Scientists

Appolinaire Djikeng, Director and genomics scientist

Francesca Stomeo, Capacity building

Franklin Simtowe, Monitoring, evaluation and learning scientist*

Jagger Harvey, Plant molecular biologist

Josephine Birungi, Technology manager

Leah Ndungu, Program coordinator

Monday Ahonsi, Program coordinator*

Morris Agaba, Molecular geneticist**

Roger Pelle, Molecular parasitologist

Sita Ghimire, Plant pathologist

Wellington Ekaya, Capacity building

Post-doctoral scientists

Bombom Alexander, Plant geneticist**

Josiah Mutuku, Plant pathologist

Mark Wamalwa, Bioinformatician

Nasser Yao, Plant molecular breeder

Visiting scientists

Samuel Mutiga, Plant pathologist (post-doc)

Tilly Eldridge, Plant geneticist (post-doc)

Research associates

Ben Kiawa, Unit coordinator, Sequencing, Genotyping, OligoSynthesis and Proteomics (SegoliP) Unit

Collins Mutai, Brachiaria project

David Oyoo Ezra, Unit coordinator, Central Core

Dedan Githae, Bioinformatician

Eunice Machuka, Capacity building

Immaculate Wanjuki, Aflatoxin project

Inosters Nzuki, Sequencing, Genotyping, OligoSynthesis and Proteomics (SegoliP) unit*

James Wainaina, Aflatoxin project***

Joyce Nzioki, Bioinformatician

Leah Kago, Brachiaria project

Lucy Muthui, Sequencing, Genotyping, OligoSynthesis and Proteomics (SegoliP) unit

Martina Kyalo, Capacity building

Mercy Macharia, Molecular diagnostics***

Moses Ndotono Njahira, Capacity building*

Pauline Asami, Plant tissue culture and transformation

Robert Ngeno, Analytical chemist

Sarah Osama, Genetic diversity ***

Technical support

Agnes Mburu, Technical management assistant

Cyrus Too, Greenhouse supervisor*

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, General laboratory assistant

Samuel Njoroge, Technical assistant, Central Core*

Winnie Muoka, Laboratory assistant

Research support

Berine Ada, Program accountant*

David Barasa, Program assistant

Edith Ng'ang'a, Project accountant

Ethel Makila, Communications officer

Helen Altshul, Development partnerships specialist

Jacqueline Mayira, Program assistant*

Marvin Wasonga, Administrative assistant,

Monicah Njuguna, Laboratory procurement assistant

Rachael Mwangi, Program management officer

Rachel Njunge, Administrative assistant*

Valerian Aloo, Capacity building officer

*Left the BecA-ILRI Hub in 2015

** Left to re-join NARS

***Left for further studies

****joint position with the IBP (GCP)

AFRICAN NARS VISITING SCIENTISTS

AFRICA BIOSCIENCES CHALLENGE FUND FELLOWS

Burundi

Michel Ntimpirangeza, Moso Research Station, officer-in-charge, *Virus discovery and development of a LAMP diagnostic test for Taro-infecting viruses in Burundi*

Cameroon

Ache Acha, University of Buea, PhD student, *Molecular identification and nutrient composition of wild edible and medicinal mushrooms from the Kilum-Ijim forest reserve, northwest Cameroon*

Anoumaa Mariette, University of Dschang, PhD student, *Genetic characterization of potato (*Solanum tuberosum* L.) from Cameroon using morphological and microsatellite markers*

Arouna Njyou, Université des Montagnes, deputy coordinator, *Epidemiology and ecology of the African swine fever in agroforest system: case of Cameroon*

Christian Keambou, University of Buea, lecturer, *Investigating the expression profile of growth, reproduction- and immune-related genes in local chicken under natural growth promoters and organic feeding*

Joseph Fovo, University of Dschang, senior lecturer, *Molecular diagnosis of diseases and mycotoxins associated with edible non-timber forest products of socioeconomic importance in Cameroon*

Judith Makombu, University of Buea, lecturer, *Morphological and molecular identification of fresh water prawn of genus *Macrobrachium* in south region of Cameroon*

Silatsa Barberine, University of Dschang, PhD student, *Evaluation of CD8 T-cell antigen Tp2/heat shock fusion protein (Tp2/gp96) delivery system: antigen production and immunogenicity study*

Côte d'Ivoire

Ahou Gbotto, Nangui Abrogoua University, PhD student, *Setting up an evaluation of a core collection of the indigenous oilseed *Citrullus lanatus* germplasm from West Africa with agronomic traits and molecular markers*

Democratic Republic of Congo

Aganze Bigman, Institut supérieur pédagogique de Bukavu, lecturer, *MCH polymorphism in indigenous chicken populations in Bukavu, eastern Democratic Republic of Congo: population's structure, diversity and distribution*

Ahadi Birindwa, Evangelical University of Africa, researcher, *Molecular characterization and Sero-surveillance of pest des petits ruminants in the African Great Lakes region: Reported cases from Burundi, Democratic Republic of Congo and Rwanda*

Gaston Amzati, Evangelical University of Africa, lecturer, *Eco-epidemiology of East Coast fever: cross-sectional, longitudinal and genetics studies of *Rhipicephalus appendiculatus* and *Theileria parva* in Burundi, eastern Democratic Republic of Congo and Rwanda*

Equatorial Guinea

Sebastian Mengomo, Agro-Forestry Training School of Bata Littoral, attached training unit commander, *Animal disease diagnostics; case of Equatorial Guinea*

Eritrea

Asmerom Habte, National Agricultural Research Institute, research assistant, *Assessment of the genetic diversity of Eritrean cowpea accessions based on microsatellite markers*

Biniam Ghebreslassie, Hamelmalo Agricultural College, researcher, *Characterization of Eritrean potato genotypes using molecular markers*

Tadesse Haile, National Agricultural Research Institute, researcher, *Molecular and phytochemical characterization of Spider Plant accessions*

Tesfamichael Abbraha, Hamelmalo Agricultural College, scientist, *Diversity analysis of Eritrean sorghum landraces for drought tolerance using molecular markers*

Ethiopia

Abel Debebe Mitiku, EIAR, researcher, *Invitro protocol optimization for virus elimination and multiplication of Garlic (*Allium sativum* L.) 'Bishoftu nich'*

Alemu Abate Asfaw, Aksum University, lecturer, *Morphological, nutritional and molecular diversity of Ethiopian grass pea (*Lathyrus sativus* L.) accessions*

Asfaw Kifle Wadollo, Southern Agricultural Research Institute, researcher, *Investigation of genetic and agro-ecological variability in Ethiopian taro (*Colocasia esculenta* L. Schott) accessions to ensure food security and alleviation of poverty: implication on conservation and breeding*

Asheber Tegegn, Ethiopian Institute of Agricultural Research, associate researcher, *Molecular characterization and genetic diversity of Ethiopian *Brachiaria* ecotypes using simple sequence repeat marker technique*

Asmare Dagnew Moges, Ethiopian Institute of Agricultural Research, researcher, *Development of microsatellite markers for the genetic analysis of Psuedocercospora angolensis from Ethiopia*

Atnaf Mulugeta, Ethiopian Institute of Agricultural Research, researcher, *Genotyping neglected multipurpose Ethiopian indigenous white lupin accessions to harness its genetic diversity*

Basazen Fantahun, Ethiopian Biodiversity Institute, researcher, *Quality and diversity assessment of farmers' varieties of Ethiopian durum wheat*

Dawit Beyene, EIAR, PhD student, *Metagenomics analysis of taro viruses in East Africa*

Getinet Mekuriaw Tarekegn, Bahir Dar University, lecturer, *Molecular characterization of indigenous goat breeds of Ethiopia: genetic diversity, DNA profiling and fine mapping of genes of selected traits*

Goshu Mizganaw, Wondogenet College of Forestry and Natural Resources, lecturer, *Bacterial and fungal endophytes of Brachiaria species*

Manyazewal Anberber, College of Veterinary Medicine and Agriculture, Addis Ababa University, assistant professor, *Molecular epidemiology of cryptosporidium infections in humans and cattle in Addis Ababa and its environs*

Tadesse Eguale Aklilu, Lemma Institute of Pathobiology, scientist, *Molecular characterization of drug resistance determinants of Salmonella isolates from humans and animals in central Ethiopia*

Tiruneh Ashenafi, University of Gondar, lecturer, *Genetic diversity of Avena species using agro-morphological, cytological and molecular markers from Ethiopia*

Gabon

Sylvere Mboumba, Masuku University of Science and Technology, assistant lecturer/researcher, *Characterization of local chicken from Gabon and valuation of their genetic heritage*

Kenya

Bernard Korir, KALRO, research scientist, *Effects of selected supplements of beef cattle productivity and rumen microbiology in Makueni County*

Carolyne Omukoko, Chuka University, lecturer and PhD student, *Beauveria bassiana as an endophyte to control red spider mites Tetranychus evansi in potatoes*

Damaris Mwangi, UoN, lecturer and PhD student, *Microbial communities associated with Pennisetum mezianum, Chrysopogon aucheri and Chloris roxburghiana from the rangelands of Northern Kenya*

David Odongo, UoN, senior lecturer, *Molecular cloning and expression of a vaccine antigen against infection with the larval stage of Echinococcus granulosus*

Davis Gimode, Kenyatta University, research scientist, *Development of genomic resources for finger millet breeding through transcriptome analysis*

Dorcus Omoga, Central Veterinary Laboratories, research scientist, *Improvement of the diagnostic capacity for diseases caused by capripox viruses*

Elijah Nyamwange, KALRO, research scientist, *Assessing the viability of pasture germplasm conserved at the national genebank of Kenya*

Eric Mikwa, Kenyatta University, research scientist, *Transcriptome analysis of finger millet at critical stages of Striga infestation*

Felix Kibegwa, UoN, tutorial fellow, *Metagenomic analysis of dairy cattle rumen microbiota: Changes in rumen microbial diversity under varying smallholder production systems and its effect on productivity*

Florence Munguti, KEPHIS, research scientist, *PCR based diagnostics of passion fruit woodiness disease in support of phytosanitary services*

Francis Mwatuni, KEPHIS, officer-in-charge, *Distribution, molecular characterization and genetic diversity of viruses that cause maize lethal necrosis disease in Kenya*

Fredah Rimbeira, JKUAT, senior lecturer, *Genetic diversity and association mapping of carotene production of mango germplasm from Kenya*

Henry Nzioki, KALRO, research scientist, *Identification, occurrence and distribution of Brachiaria diseases in Kenya*

Irene Njagi, KALRO, senior research scientist, *Development of protocols for regeneration and genetic transformation for Kenyan cassava cultivars*

Jane Ambuko, UoN, senior lecturer, *Molecular and phytochemical characterization of Spider Plant accessions*

Jane Githinji, Central Veterinary Laboratories, assistant director of veterinary service, *Comparative study of molecular characterization of infectious bursal disease viruses obtained from chicken in Kenya and commercial IBD vaccine strains currently in use in Kenya*

Lilian Okiro, Egerton University, lecturer and PhD student, *Detection of Ralstonia solanacearum species by loop mediated isothermal amplification*

Milcah Kigoni, Kenyatta University, research scientist, *Prediction of immune responsive epitopes in Theileria parva and its tick vector Rhipicephalus appendiculatus*

Ndanu Anne, Kenyatta University, part-time lecturer, *Uncoupling interaction between maize chlorotic mottle virus and sugarcane mosaic virus to develop virus resistant maize*

Nina Wambiji, Kenya Marine and Fisheries Research Institute, scientist, *Application of next generation sequencing approaches to assess the genetic diversity of rabbitfish species from Kenya*

Sheila Okoth, UoN, professor, *Characterization of Aspergillus Flavus isolates from maize kernel and maize cropped soils from different maize growing regions of Kenya*

Stephen Abwao, Egerton University, lecturer, *Regeneration and transformation of Kenyan Taro (*Colocasia esculenta*) cultivars via indirect somatic embryogenesis*

Triza Tonui, JKUAT, masters student, *Gene expression profiling during early stages of infection of bovine cells by the parasite *Theileria parva**

Nigeria

Olufunke Oluwole, Institute of Agricultural Research and Training, Obafemi Awolowo University, lecturer *Swine Leukocyte antigen characterization of Nigerian indigenous pig for disease resistance*

Titilayo Falade, Doreo Institute, adjunct agricultural research scientist, *Rapid diagnosis of aflatoxins in maize using near infrared spectroscopy*

Rwanda

Doreen Mutoni, RAB, plant, genetic resource officer, *Genotyping preferred bean varieties for marker discovery*

Godelieve Mukamurezi, RAB, research scientist, *Occurrence and distribution of mycotoxins in grain, case study: aflatoxin in rice from Rwanda*

Jean de Dieu Ayabagabo, University of Rwanda, assistant lecturer, *Genetic diversity of Rwandan Napier grass (*Pennisetum purpureum*) ecotypes and associated microbial communities for breeding and conservation*

Kizito Nishimiwe, University of Rwanda, lecturer, *Molecular and phytochemical characterization of Spider Plant accessions*

Marguerite Niyibituronsa, RAB, assistant research fellow, *Evaluation of flavor and aflatoxin in soybean milk for increased consumption and improved health*

Marie Christine Dusingize, College of Agriculture, Animal Sciences and Veterinary Medicine, University of Rwanda, lecturer, *Morphological and genetic diversity of Rwandan *Brachiaria* ecotypes and associated microbial communities*

Richard Habimana, University of Rwanda, assistant lecturer, *Assessment of genetic variation in indigenous chicken populations in Rwanda*

South Sudan

Richard Zozimo, Ministry of Agriculture, Forestry, Cooperative and Rural Development, researcher, *Genetic diversity analysis of sorghum landraces in South Sudan*

Sudan

Rasha Adam, Biosafety and Biotechnology Research Center, ARC, lecturer, *Agrobacterium mediated transformation of sorghum*



Tanzania

Benigni Temba, Sokoine University of Agriculture, researcher, *Mycotoxins and mycotoxigenic fungi in maize in East Africa: Surveillance and characterization*

Fatma Hussein, NMAIST, PhD student, *Identification and characterization of viruses causing MLND in northern Tanzania*

Salum Kuwi, Tanzania Livestock Research Institute, researcher, *Analysis of genetic diversity of Tanzanian Brachiaria ecotypes*

Uganda

Clementine Namazzi, National Livestock Resources Research Institute, research technician, *Agro-morphological, nutritional and genetic characterization of Brachiaria accessions obtained from the different agro-ecologies of Uganda*

Fred Bwayo Masika, Uganda Christian University, research assistant, *Single nucleotide polymorphism discovery and validation in Solanum aethiopicum*

Jacinta Akol, NaCRRI, scientist, *Development of tissue culture protocol for production of quality farmer preferred yam planting material*

John Walakira, National Fisheries Resources Research Institute, scientist, *Developing a SNP panel as tool to determine the genetic diversity and guide domestication of African lungfish*

Rachel Aye, Gulu University, assistant lecturer, *Selection of Mycoplasma mycoides subsp. mycoides candidate vaccine molecules through the identification of monoclonal antibodies that inhibit pathogen-host cell adhesion*

Robert Mwesigwa, NARO, research officer, *Abundance and diversity of fungal endophyte communities associated with local Brachiaria ecotypes*

Sandra Kamenya, Uganda Christian University, lecturer, *Developing genomic tools for Solanum aethiopicum breeding and gene discovery*

Victoria Tibenda, Aquaculture Research and Development Center, researcher, *Improving nutritional value and profit for aquaculture in the Lake Victoria Basin—East Africa*

Zambia

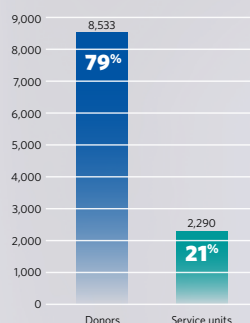
Kabamba Mwansa, Zambia Agriculture Research Institute, researcher, *Characterization of maize inbred lines used by Zambia Agriculture Research Institute using genotyping by sequencing*



STATEMENT OF INCOME AND EXPENSES IN 2015

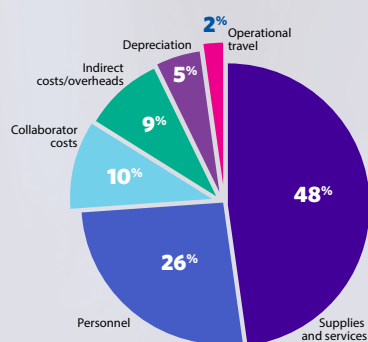
Income and expenses 1 January–31 December 2015

USD '000

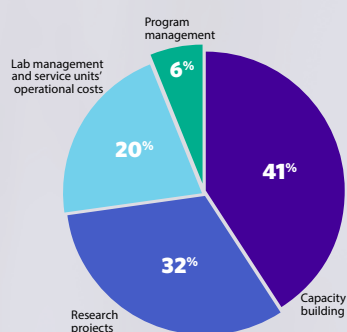


Income source	USD '000	Percentage %
Donors	8,533	79
Service units	2,290	21
Total income	10,823	100

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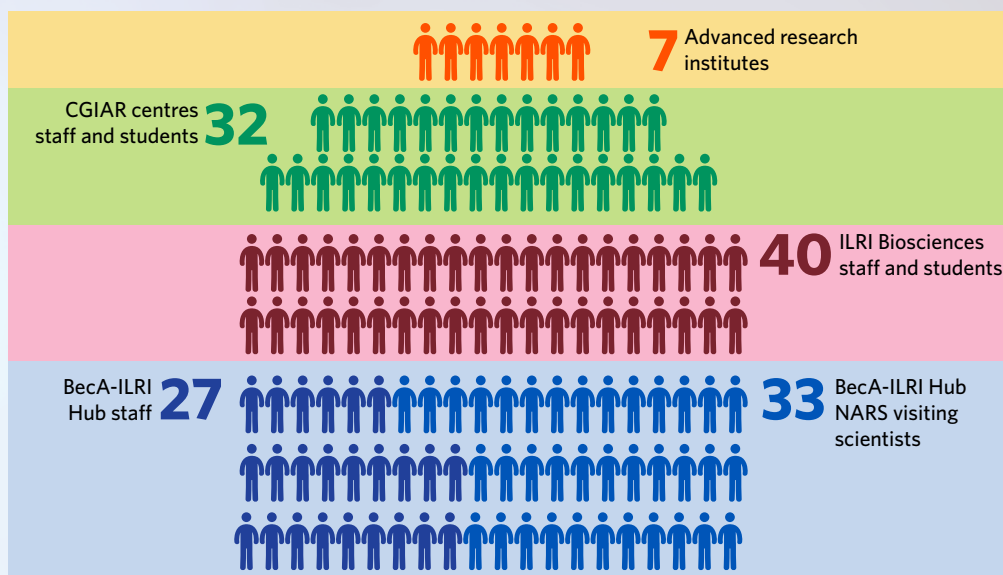
Expenditure by natural classification	USD '000	Percentage %
Personnel	2,814	26
Collaborator costs	1,131	10
Supplies and services	5,181	48
Operational travel	221	2
Depreciation	518	5
Indirect costs/overheads	959	9
Total expenditure	10,823	100



Expenditure by activity	USD '000	Percentage %
Program management	698	6
Capacity building	4,420	41
Lab management and service units	2,290	21
Research projects	3,415	32
BecA-ILRI Hub asset replacement reserve	-	-
Total expenditure	10,823	100

LAB USAGE FULL-TIME EQUIVALENTS

for the period 1 January–31 December 2015



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Visiting scientist Joseph Fovo from University of Dschang, Cameroon at the BecA-ILRI Hub

LIST OF ACRONYMS

ABCF Africa Biosciences Challenge Fund	ICRISAT International Crops Research Institute for the Semi-Arid Tropics
AGRA Alliance for a Green Revolution in Africa	IFAD International Fund for Agricultural Development
APTECA Aflatoxin Proficiency Testing and Control in Africa	IFPRI International Food Policy Research Institute
ARC Agricultural Research Corporation	IGSS Integrated Genotyping Service and Support
ASARECA Association for Strengthening Agricultural Research in Eastern and Central Africa	IITA International Institute of Tropical Agriculture
ASF African swine fever	ILRI International Livestock Research Institute
AU-IBAR African Union-InterAfrican Bureau for Animal Resources	IP innovation platform
AU/NEPAD African Union's New Partnership for Africa's Development	IRAD Institut de Recherche Agricole pour le Développement
AWARD African Women in Agricultural Research and Development	ISID International Society of Infectious Diseases
BBSRC Biotechnology and Biological Sciences Research Council	JIC John Innes Centre
BecA-ILRI Hub Biosciences eastern and central Africa-International Livestock Research Institute Hub	JKUAT Jomo Kenyatta University of Agriculture and Technology
BMGF Bill & Melinda Gates Foundation	KALRO Kenya Agricultural and Livestock Research Organization
BMS breeding management System	KEPHIS Kenya Plant Health Inspectorate Service
CERAAS Centre d'étude Régional pour l'Amélioration de l'Adaptation à la Sécheresse	LMEO Laboratory Management and Equipment Operation
CGIAR Consultative Group for International Agricultural Research	MARI Mikocheni Agricultural Research Institute
CIAT International Center for Tropical Agriculture	MLND maize lethal necrosis disease
CIP International Potato Center	MoU memorandum of understanding
CoP community of practice	NaCRRI National Crops Resources Research Institute, Uganda
CORAF/WECARD West and Central African Council for Agricultural Research and Development	NARO National Agricultural Research Organization, Uganda
CSIRO Commonwealth Scientific and Industrial Research Organisation	NARS national agricultural research system
DArT Diversity Arrays Technology Pty. Ltd., Canberra, Australia	NEPAD New Partnership for Africa's Development
DArTSeq Diversity Arrays Technology pipeline	NERICA New Rice for Africa
DBT Department of Biotechnology of India's Ministry of Science and Technology	NMAIST Nelson Mandela African Institution of Science and Technology
DFAT Department of Foreign Affairs and Trade, Australia	OFSP orange-fleshed sweet potato
DFID UK Department for International Development	PEARLS Program for Emerging Agricultural Research Leaders
ECABREN Eastern and Central African Bean Research Network	QUT Queensland University of Technology
ECF East Coast fever	RAB Rwanda Agriculture Board
EIAR Ethiopia Institute of Agricultural Research	RADES-PCR randomly amplified differentially expressed sequence polymerase chain reaction
ENSA Engineering Nitrogen Symbiosis for Africa	S3A Science Agenda for Agriculture in Africa
FANEL Food and Nutritional Evaluation Laboratory	SCPRID Sustainable Crop Production Research for International Development
FAO Food and Agriculture Organization of the United Nations	SDGs Sustainable Development Goals
FARA Forum for Agricultural Research in Africa	SFSA Syngenta Foundation for Sustainable Agriculture
IBP (GCP) Integrated Breeding Platform (CGIAR Generation Challenge Programme)	Sida Swedish International Development Cooperation Agency
HPAI highly pathogenic avian influenza	SLU Swedish University of Agricultural Sciences
IBP Integrated Breeding Platform	UNCST Uganda National Council for Science and Technology
	UNESCO United Nations Educational, Scientific and Cultural Organization
	UoN University of Nairobi
	WACCI West Africa Centre for Crop Improvement

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