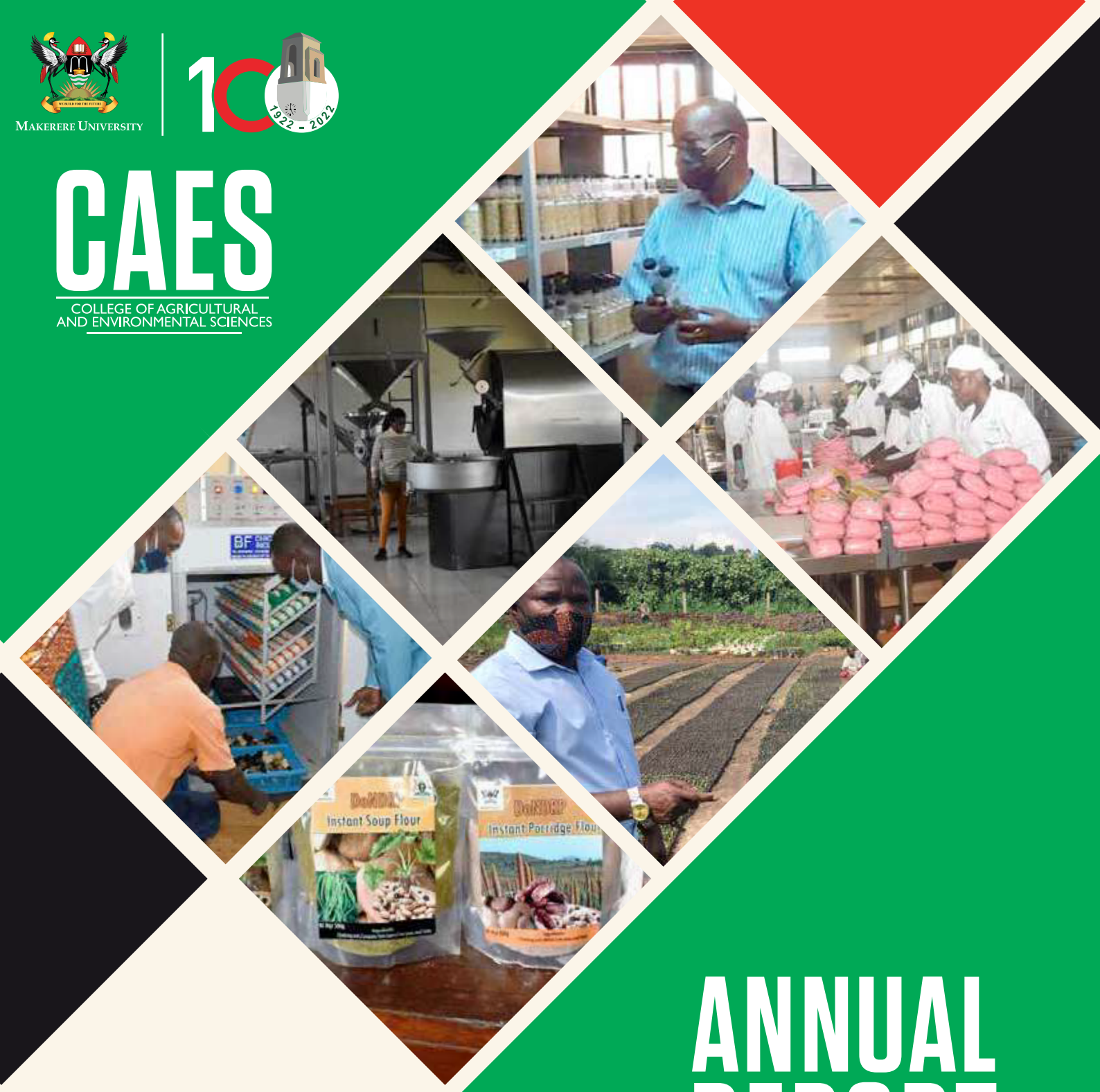
MAKERERE UNIVERSITY

1922 - 2022

CAES

COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES



ANNUAL REPORT -2021-

Concept:
Prof. Bernard Bashaasha, Principal, CAES

Compiled by:
Hasifa Kabejja, Principal Communication Officer, CAES

Editors:
Prof. Bernard Bashaasha, Principal, CAES
Hasifa Kabejja, Principal Communication Officer, CAES
Tonny Obua, Lecturer, School of Agricultural Sciences

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LIST OF ACRONYMS

AfDB	African Development Bank
ARUA	African Universities Alliance
CAES	College of Agricultural and Environmental Sciences
DABE	Department of Agricultural and Bio-Systems Engineering
DANRE	Department of Natural Resource Economics
DAP	Department of Agricultural Production
DEIS	Department of Extension and Innovation Studies
DEM	Department of Environmental Management
DFTHN	Department of Food Technology and Human Nutrition
DGGCS	Department of Geography, Geo-informatics and Climatic Sciences
DRGT	Directorate of Research and Graduate Training
FBT	Department of Forestry, Biodiversity and Tourism
FTBIC	Food Technology and Business Incubation Centre
MAK	Makerere University
MaRCCI	Makerere University Regional Centre for Crop Improvement
MUARIK	Makerere University Research Institute Kabanyolo
MUBFS	Makerere University Biological Field Station
NBDB	National Biodiversity Data Bank
NEF	Next Einstein Fellowship
NFC	Nyabyeya Forestry College
SAS	School of Agricultural Sciences
SFEGS	School of Forestry, Environmental and Geographical Sciences
SFTNB	School of Food Technology, Nutrition and Bioengineering
USAID	United States Agency for International Development
WSU	Western Sydney University

COLLEGE LEADERSHIP

Prof. Bernard Bashaasha
Outgoing Principal

Dr. Gorettie N. Nabanoga
Former Deputy | Incoming Principal

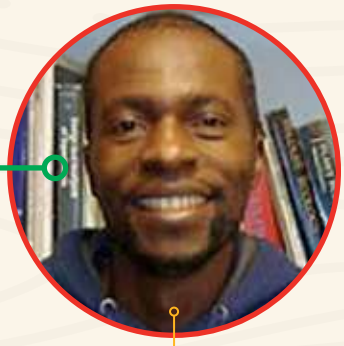
DEANS

Dr Johnbaptist Tumuhairwe
Dean, School of Agricultural Sciences

Dr. Fred Babweteera
Dean, School of School of Forestry, Environmental and Geographical Sciences

Dr. Abel Atukwase
Dean, School of Food Technology, Nutrition & Bio-Engineering

Dr Cyrus Ongom Okello
Director, MUARIK



Prof. David Tumusiime
Director, Makerere University Biological Field Station (MUBFS)

HEADS OF DEPARTMENT

Dr. Mildred Ochwo Semakula
Head, Department of Agricultural Production

Dr. Gabriel Elepu
Head, Department of Agribusiness, & Natural Resource Economics

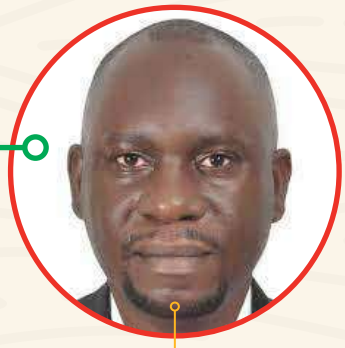
Prof. Turyahabwe Nelson
Head, Department of Extension, & Innovation Studies

Dr Justine Namalwa
Head, Department of Environmental Management

Dr. Frank Mugagga
Head, Department of Geography, Geoinformatics and Climatic Sciences

Dr. Edward Mwavu
Head, Department of Forestry, Biodiversity & Tourism

Dr. Isa Kabenge
Head, Department of Agricultural and Bio-Systems Engineering



Dr. Mukisa Muzira Ivan
Head, Department of Food Technology and Nutrition

FOREWORD

The College of Agricultural and Environmental Sciences (CAES) undertakes basic, strategic and applied research and development in the broader areas of agriculture, food technology and nutrition, forest management and environment, and natural resources management. In agriculture, research and development programmes have focused on enhancing farmer centred approaches, climate smart agricultural systems, value chain improvement for the achievement of food and nutritional security, livelihood improvement and overall rural development. The College has also pioneered R&D in biotechnology, integrated pest and disease management, linking producers to markets as well as incubation of innovation for market products.

Despite the COVID-19 disruptions, 2021 remained a fairly stable year, providing room for many of our staff and students to continue engaging in cutting-edge research activities. Many of our staff, working with students and engaging industry partners continued to write grant winning proposals. An example of this is the recently launched Sustainable Off-grid solutions for Pharmacies and Hospitals in Africa (SophiA) project. The four-year multi-disciplinary project will benefit both Makerere and the Health system in remote parts of the country by granting access to off-grid carbon-neutral electricity, heating and cooling of food and medicines, storage of vaccines up to -70°C as well as access to safe and clean drinking water. Makerere is partnering with 13 organizations across Europe and Africa in the project funded by the European Union to ensure extended support to Health Centre Fours (HC IVs) across four African countries namely: Burkina Faso, Cameroon, Malawi, and Uganda.

Others projects obtained in 2021 include; the ILRI supported Community Based Artificial Insemination aimed at improving pig productivity in the country; the Gender Research Capacity Building/ Gender Responsive Researches Equipped for Agricultural Transformation (GREAT II); the National Research and Innovation Programme supported by the Government of Uganda, through the Ministry of Science, Technology and Innovation; Explaining inclusive lower-level urbanization in Tanzania and Uganda Funded by SIDA, Sweden; Capacity Building for Socially Just and Sustainable Energy Transitions supported by NORAD under NORHED II Programme (Energy Sub programme); and Unlocking the Potential of Smallholders for Urban Food System Resilience in Uganda funded by SIDA under Phase II of AgriFoSe2030 Programme. Our researchers also won a number of grants under the Makerere University Research and Innovations Fund (Mak-RIF). Through these and many other ongoing research projects highlighted in this edition, our researchers continued to actively support and guide citizens on better farming practices for improved productivity and income generation.

With support from the government and international partners, our researchers developed a number of innovations in the period under review. These included the Push-Pull App" to guide farmers control maize and sorghum pests; a hybrid solar dryer for perishable agricultural products; Recipes & Products for People Living with HIV/AIDS; improved soybean varieties; enhanced potato-Sorghum enterprises; and an incubator with the capacity of 1000 eggs at the University Agricultural Research Institute Kabanyolo (MUARIK) for training, research and farmers' capacity building.

FOREWORD

In this edition, we further share with you highlights of research activities that our staff and students engaged in. These include; training of livestock farmers on Climate-Smart Supplementary Feeding Technologies; training pig farmers on Artificial Insemination to improve pig productivity; promoting feedlot technology to boost livestock production in the Cattle corridor; promoting use of Urea Molasses Blocks as supplements for beef production; skilling livestock Farmers on Pasture Production and Management; guiding farmers and Agricultural Extension Officers on provisional fertilizer rates in low land rice production areas; sensitizing Agriculture Extension Officers and farmers on the right fertilizer package for Bananas and fertilizer application for upland rice and maize; the launch of Makerere Drylands Transform Project in Moroto District; and skilling roadside plant nursery owners on business management and sustainable practices. I am happy to report that under the Drylands Transform Project, Makerere was granted 10 Hectares in Poron, Napak to set up Livestock Café & Tick Control Demos. In the same regard, Makerere secured another 10 Hectares in Rupa Sub-County, Moroto District for Livestock Café. We are indeed grateful to the district and local leaders in Napak and Moroto districts for this generous gesture.

Our staff and students also engaged in a number of academic and research seminars including; the 2nd Policy Seminar on Rural Development; the 4th Policy Seminar on Rural Development in Uganda; GREAT Theme 5 Virtual Course aimed at equipping Agricultural Researchers with knowledge on Gender Responsiveness; the EfD-Mak Centre Policy Dialogue on changes in Lake Victoria; the NIL project First Contributing Authors' Workshop; and the launch of the SDSN Uganda Network at Makerere.

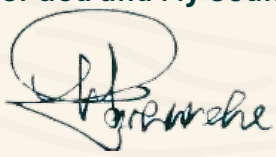
I am also happy to note that in 2021 and during the last half of 2020, our researchers published over 331 books, book chapters and articles in internationally recognized journals. It is also gratifying to note that Makerere University was recognized at the 5th Africa-wide Agricultural Extension Week (AAEW) for its contribution to research and training.

We sincerely appreciate the Government of Uganda and all Development Partners for the support extended to us over the years.

2021 was my last year of service as Principal CAES. I take this opportunity to appreciate Makerere University Management for entrusting me with this responsibility for 8 and a half years. Special regards to all staff and students of CAES. Without your support and cooperation, the achievements registered would not be possible. I will forever remain indebted.

May we continue with the teamwork exhibited over the years to take CAES to greater heights and make the College a Continental Centre of Excellence in matters relating to Agriculture and Environment. I pledge continued support to the new Principal and everyone at CAES as We continue Building for the Future.

For God and My Country!



Prof. Bernard Bashaasha
Outgoing Principal, CAES

VISION

To be a thought leader of knowledge generation for societal transformation and development

MISSION

To produce graduates, research products and knowledge services in the fields of agricultural, food technology and environmental management

UNVEILING THE MAK@100 LOGO AND LAUNCH OF THE YEAR-LONG ACTIVITIES

Established in 1922, Makerere University will celebrate 100 years in October 2022. On 9th October 2021, the President of the Republic of Uganda, H.E Yoweri Kaguta Tibuhaburwa Museveni launched the Mak@100 logo symbolizing the launch of activities to celebrate 100 years of Makerere University. Activities lined up for the celebration include profiling and sharing of experiences by Makerere University alumni, profiling research achievements/innovations over the years, exhibition to showcase research and innovations, radio and TV talk-shows and fundraising events.

The President unveiling the Mak@100 logo at Kololo Independence Grounds

INTRODUCTION

Makerere University College of Agricultural and Environmental Sciences (CAES) is one of the 10 Constituent Colleges of Makerere University. The College was formed through a merger of the former: (i) Faculty of Agriculture, (ii) Faculty of Forestry and Nature Conservation, (iii) Makerere University Institute of Environment and Natural Resources; and (iv) Department of Geography. The College is made up of three schools: School of Agricultural Sciences (SAS), School of Food Technology, Nutrition and Bioengineering (SFTNB), and the School of Forestry, Environmental and Geographical Sciences (SFEGS), which together have eight Departments.

In addition, CAES has two research institutes namely: Makerere University Research Institute Kabanyolo (MUARIK) and Makerere University Biological Field Station (MUBFS). The College also has 14 centres that serve a base for knowledge transfer and partnerships, these are complemented by facilities located at Nyabyeya Forest College and Budongo Conservation Field Station that cater for Forestry students. The College has 373 members of staff and over 3,000 students.

PURPOSE OF THE COLLEGE

The purpose of the CAES and Makerere University at large is derived from the mandate of Universities and Other Tertiaries Institutions Act (UOTIA) as amended:- a) the provision of higher education, promotion of research and advancement of learning; b) dissemination of knowledge and giving opportunity of acquiring higher education to all persons including persons with disabilities regardless of the race, political affiliation, colour, creed or sex and; c) the provision of accessible physical facilities to the users of public universities. CAES, with its mandate of providing leadership in training, research and community engagement in agriculture and environment management is thus a critical actor in the achievement of Uganda National Development Agenda, and in a sustainable manner.

Through CAES, Makerere University collates critical national to global knowledge centres for sustainable agricultural development and environmental management. The College has 900.08m^2 of teaching space on campus complemented by off-campus space, eight libraries, 19 research laboratories, six computer laboratories, and one GIS laboratory. In terms of human resources, CAES has a total of 373 employees of which 20 are full Professors and 27 are at the rank of Associate Professor. Of the 373 staff, 72 are contract staff paid at the college level.

SCHOOLS AND DEPARTMENTS

The college has three schools and eight departments.

The School of Agricultural Sciences (SAS) is comprised of three Departments:

- Agricultural Production (DAP)
- Agribusiness and Natural Resource Economics (DANRE)
- Extension & Innovation Studies (DEIS)

The School of Forestry, Environmental and Geographical Sciences (SFEGS) is composed of three departments:

- Forestry, Biodiversity and Tourism (FBT)
- Environmental Management (DEM)
- Geography, Geo Informatics and Climatic Sciences (GGCS)

The School of Food Technology, Nutrition and Bioengineering (SFTBN) comprises two departments:

- Agricultural and Biosystems Engineering (DABE)
- Food Technology and Nutrition (FTHN)
- The SFTNB also hosts the Food Technology and Business incubation Centre(FTBIC)

Table 1: Summary Of The 15 Research Institutes/Centres

NO.	NAME OF RESEARCH INSTITUTE/ CENTRE	PURPOSE	LEGAL STATUS COLLEGE CENTRE/ COMPANY
1	Makerere University Agricultural Research Institute (MUARIK) (Dr. Cyrus Okello Ongom)	• A multi-disciplinary facility for training, research, outreach and production • Interface with the National Agricultural research system (NARS) • Currently has 28 cows, 1,240 broilers, 15,000 layers and 33 pigs	College Centre in Wakiso
2	The Makerere University Biological Field Station (MUBFS) (Prof. David Tumusiime)	Conduct research and host short international courses in tropical biology, ecological and behavioral research on taxonomy, and socio economic studies	College Centre in Kabarole and Kamwenge districts
3	The Food Technology and Business Incubation Centre (FTBIC) (Dr. Yusuf Byaruhanga)	Conduct research in agro-processing and value addition, Train students, staff and the general community in entrepreneurship, Nurture research ideas into Business enterprises and commercial products, Carry out skills training (short courses) using the installed equipment for potential entrepreneurs in food value addition	College Centre on main campus

4	Makerere University Regional Centre for Crop Improvement (MaRCCI) (Dr. Richard Edema)	• Expand, strengthen and transform the PhD Plant Breeding programme following the pattern of the highly successful MSc in Plant Breeding and Seed Systems • Provide the nations of Eastern and Southern Africa (ESA) with industry-ready plant breeders who are equipped to use cutting edge science to develop and deliver new varieties of food crops	College Centre at MUARIK
5	Makerere University Centre of Excellence in Waste Management (Dr. Constantine Katongole)	• To become a centre of innovative research and technology development utilizing bio waste (agricultural/ organic wastes) in enhancing sustainable agricultural production and a healthy environment • Optimize and promote compositing of biodegradable waste for improved agricultural production • Develop livestock feed protocols based on market crop waste • Develop biogas technologies for use by small scale households • Offer training, knowledge sharing and advisory services in waste management and create linkages with the private sector in technology development • Promote the adoption and diffusion of viable waste utilization technologies and products • Promote regional and international research collaborations and linkages and create community awareness and training through linkages	College Centre at MUARIK
6	Makerere University Centre for Climate Change Research and Innovations (MUCCRI) (Dr. Revocatus Twinomuhangi)	• Promote awareness on climate change • Conduct research on climate change science, climate change mitigation and adaptation in all sectors and disseminate the generated information • Generate and disseminate innovations for climate change mitigation and adaptation in agricultural sciences and natural resources sectors • Advocate and influence climate change and development policy to enable Uganda address climate change challenges	College Centre on main campus
7	The Makerere University Centre for Soybean Improvement and Development (MakCSID) (Prof. Phinehas Tukamuhabwa)	• To serve as a focal node for training in Plant Breeding, Seed systems and Biotechnology for the region • Provides all breeders and foundation seed for soybean, in Uganda and East Africa Region. • Conduct training of farmers and students through outreach activities • Enhance development of different soybean - Best enterprises	College Centre at MUARIK

8	The National Biodiversity Data Bank (NBDB) – Uganda (Dr. Daniel Waiswa)	• Avail data and information regarding the country's biodiversity to aid in research, conservation and informing the decision making process • Act as a central repository for biodiversity information within Uganda, • Monitor the national biological resources • Provide consultancy services to the government and other organizations in Uganda in different fields of environment and natural resources, assessment and monitoring of environment and natural resources.	College Centre on main campus
9	Uganda Forestry Resources and Institutions Centre (UFRIC), Makerere University	• Promote sustainable management of global commons including forests. • Address global challenging questions such as the impact of institutions on forest sustainability, • Collect forest inventory and socio-economic data from several parts of the globe through it's Collaborating Research Centres (CRCs) • Monitor forest resources and institutions	College Centre on main campus
10	Continuing Agricultural Education Centre (CAEC) (Dr. Bernard Obba)	• Operate outreach programmes for various stakeholders • Host refresher and specialized short courses to meet the demands as they arise in agriculture and environment	College Centre at MUARIK
11	A consortium for Enhancing University Responsiveness to Agribusiness Development (CURAD) (Prof. Samuel Kyamanywa)	Promote entrepreneurship by students and graduates of Makerere University in business incubation especially those working with agribusiness or farming	Company at MUARIK
12	Centre for Mountain Resources and Disaster Management (Dr. Frank Mugagga)	• Offer a specialized course on Highland and mountain resource management • Spearhead, conduct and coordinate issues concerning mountains and sustainable development in Uganda and beyond • Engage in research and outreach, organise and hold local and international conferences, thus contributing to documentation and sharing of knowledge on mountains	College Centre on main Campus
13	Agricultural Policy Research Centre (Dr. Gabriel Elepu)	• Handles interface with the policy processes	College Centre anchored in DANRE, main Campus
14	Makerere University Tissue Culture Laboratory (MAKTCLAB) (Dr. S.B. Mukasa)	• Contributes to food security, income generation and livelihood improvement through commercializing quality tissue culture planting material in Uganda. The Laboratory affords quick production of clones identical to the source plant in large numbers that are often free from pests and diseases	College Centre at MUARIK
15	Centre for Environment and Development (Prof. Johnny Mugisha)	• Deals with issues at the interface of the Environment and development objectives	Co-hosted with COBAMS. The Director is from COBAMS

TEACHING & LEARNING

i) Academic Programmes of the College

As at 2021, the College was offering 15 undergraduate programmes and 24 graduate programmes in the broad areas of agriculture, food science and nutrition, forestry, environmental and geographical sciences. Of these six (6) new programmes (2 Undergraduate and 4 graduate were developed during the last 8 years). Sadly, some relevant programmes of the college were recently dropped on the recommendation of a Council committee. The breakdown of the programmes by school is as follows:

Table 2: Undergraduate and Graduate programmes

NO.	SCHOOL	PROGRAMMES (UNDERGRADUATE)	CODE	DURATION	FEES STRUCTURE	
					East Africans & Refugees	International Students
1.	School of Agricultural Sciences					
		Bachelor of Science in Agriculture	AGR	4 Years	2,044,056/=	3,406,760/=
		Bachelor of Agricultural and Rural Innovation	BAR	3 Years	2,129,225/=	4,301,035/=
		Bachelor of Science in Agricultural Land Use & Management (phasing out)	BAM	3 Years	1,277,535/=	1,916,303/=
		Bachelor of Science in Horticulture (phasing out)	HOT	3 Years	1,490,458 /=	2,235,686/=
		Bachelor of Agribusiness Management	AGM	3 Years	1,171,074 /=	1,756,611/=
		Bachelor of Agricultural and Rural Innovation (External)		4 Years	988,569 /=	2,570,279/=
		Graduate (Masters & PhD)				
		Master of Science in Agricultural Extension		2 Years	5 ,000,000/=	8,000,000/=
		Master of Science in Crop Science		2 Years	5,000,000/=	8,000,000/=
		Master of Science in Animal Science		2 Years	5,000,000/=	8,000,000/=
		Master of Science in Soil Science		2 Years	5,000,000/=	8,000,000/=
		Master of Science in Integrated Watershed Management		2 Years	5,000,000/=	8,000,000/=
		Master of Agribusiness Management		2 Years	5,000,000/=	8,000,000/=
		Master of Science in Plant Breeding and Seed Systems		2 Years	5,000,000/=	10,338,360/=
		Master of Science in Agricultural and Applied Economics		2 Years	5,500,000/=	7,200,000/=
		Ph.D. Plant Breeding and Biotechnology (Coursework & Dissertation)		3 Years	7,000,000/=	10,338,360/=
		Regional PhD program in Agricultural and Applied Economics		3 Years		
		Ph.D. Agricultural and Rural Innovations (Coursework & Dissertation)		3 Years	7,000,000/=	13,000,000/=

2.	School of Forestry, Environmental & Geographical Sciences	**UNDERGRADUATE PROGRAMMES**				
		Bachelor of Science in Forestry	BOF	4 Years	1,454,750/=	3,967,500/=
		Bachelor of Science in Tourism and Hospitality Management	BTH	3 Years	1,454,750/=	3,967,500/=
		Bachelor of Geographical Sciences	BGS	3 Years	1,454,750/=	3,967,500/=
		Bachelor of Science in Meteorology	BMT	3 Years	1,368,788/=	1,825,050/=
		Bachelor of Environmental Science	BVS	3 Years	1,277,535/=	1,596,919/=
		POST GRADUATE PROGRAMMES				
		Post Graduate Diploma in Environmental Impact Assessment		1 Year	5,000,000/=	8,000,000/=
		Master of Science in Forestry and Biodiversity Management		2 Years	5,600,000/=	8,985,600/=
		Master of Science in Disaster and Risk Management		2 Years	5,000,000/=	7,200,000/=
		Master of Landuse and Regional Development Planning		2 Years	5,000,000/=	7 ,200,000/=
		Master of Science in Agroforestry and Community Development		2 Years	5 ,600,000/=	8,985,600/=
		Master of Geographical Sciences		2 Years	5,000,000/=	7,200,000/=
		Master of Science in Environment and Natural Resources		2 Years	5,060,000/=	9,345,600/=
		Master of Science in Applied Meteorology		2 Years	5,000,000/=	7 ,200,000/=

3.	School of Food Technology, Nutrition & Bioengineering	**UNDERGRADUATE PROGRAMMES**				
		Bachelor of Science in Food Science and Technology	FST	4 Years	2,044,056 /=	3,406,760/=
		Bachelor of Science in Agricultural Engineering	AGE	4 Years	2,044,056 /=	3,406,760/=
		Bachelor of Science in Human Nutrition	HUN	3 Years	1,825,050 /=	3,379,384/=
		Bachelor of Science in Water and Irrigation Engineering	BWE	4 Years	2,005,600/=	3,036,000/=
		Bachelor of Science in Bioprocessing Engineering	BBP	4 Years	2,300,000/=	3,737,500/=
		Graduate (Masters)				
		Master of Science in Agricultural Engineering		2 Years	5,000,000/=	8,000,000/=
		Master of Science in Food Science and Technology		2 Years	5,000,000/=	8,000,000/=
		Master of Science in Applied Human Nutrition		2 Years	5,000,000/=	9,090,000/=
		Master of Science in Food Safety and Quality Management		2 Years	5 ,200,000/=	8,900,000/=
DOCTORAL DEGREES BY RESEARCH ONLY						
1.	PhD degrees tenable in the School of Agricultural Sciences				Shs.7,000,000/=	Shs.9,000,000/=
2.	PhD degrees tenable in the School of Forestry, Environmental & Geographical Sciences				Shs.7,000,000/=	Shs.9,000,000/=
3.	PhD degrees tenable in the School of Food Technology, Nutrition and Bio-Engineering				Shs.7,000,000/=	Shs.9,000,000/=

ii) Proposed Programmes

A number of programmes, listed below, have been identified and are in the process of being developed to address the current and future national and global agricultural development and sustainable environment and natural resources management needs of the country.

- Bachelor of Science in Animal Science and Husbandry
- Bachelor of Science in Agricultural Economics
- Bachelor of Rural Economy and Cooperative Management
- Master of Science in Integrated Animal Production Systems
- Master of Science in Horticulture
- Master of Science in Natural Resource Economics

iii) Student enrolment and graduation

As at December 2021, CAES had a total of 2,922 students. Of these 2,758 (94.4%) are undergraduate students and 164 (5.6%) are graduate students (Masters and PhD).

Table 3: Statistics of admitted students 2021/2022 Academic Year

PROGRAMME	FEMALE	MALE	GRAND TOTAL
BACHELOR OF AGRIBUSINESS MANAGEMENT	48	70	118
BACHELOR OF AGRICULTURAL AND RURAL INNOVATION	50	83	133
BACHELOR OF AGRICULTURAL AND RURAL INNOVATION EXT	15	69	84
BACHELOR OF GEOGAPHICAL SCIENCES	20	25	45
BACHELOR OF SCIENCE IN AGRICULTURAL ENGINEERING	18	28	46
BACHELOR OF SCIENCE IN AGRICULTURE	34	50	84
BACHELOR OF SCIENCE IN BIOPROCESSING ENGINEERING	14	17	31
BACHELOR OF SCIENCE IN FOOD SCIENCE AND TECHNOLOGY	23	31	54
BACHELOR OF SCIENCE IN FORESTRY	35	60	95
BACHELOR OF SCIENCE IN HUMAN NUTRITION	24	25	49
BACHELOR OF SCIENCE IN TOURISM AND HOSPITALITY MANAGEMENT	56	44	100
BACHELOR OF SCIENCE IN WATER AND IRRIGATION ENGINEERING	15	25	40
DOCTOR OF PHILOSOPHY IN PLANT BREEDING AND BIOTECHNOLOGY		5	5
DOCTOR OF PHILOSOPHY (SCHOOL OF AGRICULTURAL SCIENCES)	3	4	7
DOCTOR OF PHILOSOPHY (SCHOOL OF FORESTRY, ENVIRONMENTAL AND GEOGRAPHICAL STUDIES)	3	1	4
DORTOR OF PHILOSOPHY (SCHOOL OF FOOD TECHNOLOGY, NUTRITION AND BIO-ENGINEERING)	5	5	10
MASTER OF AGRIBUSINESS MANAGEMENT	7	12	19
MASTER OF GEOGRAPHICAL SCIENCES	4	9	13
MASTER OF LAND USE AND REGIONAL DEVELOPMENT		4	4
MASTER OF SCIENCE IN INTERGRATED WATERSHED MANAGEMENT	1	2	3
MASTER OF SCIENCE IN AGRICULTURAL AND APPLIED ECONOMICS	7	15	22
MASTER OF SCIENCE IN AGRICULTURAL ENGINEERING	2	8	10
MASTER OF SCIENCE IN AGRICULTURAL EXTENSION EDUCATION	3	8	11
MASTER OF SCIENCE IN AGRO FORESTRY AND COMMUNITY DEVELOPMENT	3	4	7
MASTER OF SCIENCE IN ANIMAL SCIENCE		3	3
MASTER OF SCIENCE IN APPLIED HUMAN NUTRITION	3	1	4
MASTER OF SCIENCE IN APPLIED METEOROLOGY	1	3	4
MASTER OF SCIENCE IN CROP SCIENCE	6	18	24
MASTER OF SCIENCE IN DISASTER RISK MANAGEMENT	4	1	5
MASTER OF SCIENCE IN ENVIRONMENT AND NATURAL RESOURCES	28	38	66
MASTER OF SCIENCE IN FOOD SAFETY AND QUALITY MANAGEMENT	4	9	13
MASTER OF SCIENCE IN FOOD SCIENCE AND TECHNOLOGY	3	4	7
MASTER OF SCIENCE IN FORESTRY AND BIODIVERSITY MANAGEMENT	3	1	4
MASTER OF SCIENCE IN PLANT BREEDING AND SEED SYSTEMS	3	5	8
MASTER OF SCIENCE IN SOIL SCIENCE	4	3	7
PHD IN AGRICULTURAL AND APPLIED ECONOMICS	4	12	16
PHD IN AGRICULTURE AND RURAL INNOVATION		5	5
POSTGRADUATE DIPLOMA IN ENVIRONMENTAL IMPACT ASSESSMENT	2	5	7
GRAND TOTAL	**455**	**712**	**1167**

iv) 71st Graduation Ceremony

Graduation statistics

Over the last three years (2019-2021), CAES has graduated at a total of 1,971 students. Of these 42 were PhDs, 24 were Post Graduate Diplomas, 266 Masters degrees and 1,639 were Bachelors' degrees of which 39% were females. In 2021, the College of Agricultural and Environmental Sciences (CAES) Management team led by the Principal, Prof. Bernard Bashaasha presented 21 PhDs, 118 Masters, 467 undergraduates and 8 Post Graduate Diploma students to the Chancellor of Makerere University, Prof. Ezra Suruma for the award of degrees and diplomas in various disciplines. The College also presented the best performer under the Chinese Female Scholarship, Mr. Opendu Thomas with a CGPA of 4.56. Of the 457 undergraduate students, 177 (37.9%) were female and 290 (62.1%) male. Of the 21 PhD students, 8 (38.1%) were female while 13 (61,9%) were male. Of the 118 Masters students, 44 (37.3%) were female while 74 (62.7%) were male. A total of 26 undergraduate students attained first class degrees with a 13 to 13 umber (a 50-50 %) of male and female students.

Table 4: Students graduation statistics 2017 – 2021

Year	Graduation	PGD			Bachelors			Masters			PhD			Total
		F	M	Sub-tot.	F	M	Sub-tot.	F	M	Sub-tot.	F	M	Sub-tot.	
2017	67th graduation	1	1	2	213	333	546	28	60	88	2	8	10	646
2018	68th graduation	2	1	3	238	437	675	68	44	112	3	15	18	808
2019	69th graduation	0	9	9	260	389	649	34	54	88	3	7	10	756
2020	70th graduation	2	5	7	197	326	523	25	48	73	5	11	16	619
2021	71st graduation	2	6	8	176	291	467	43	62	105	10	6	16	596
Cumulative Total				**29**			**2,860**			**466**			**70**	**3,425**

Source: Makerere University Graduation Booklets (2017-2021)

Prof. Ezra Suruma confers a PhD Upon one of the CAES students

Pictured above: The Best performing BARI student Chinese Female Scholarship, Mr. Opendu Thomas.
Below: Some of the CAES Masters students attending the graduation ceremony

v) Mak honours AfDB President Dr. Akinwumi Ayodeji Adesina

The President of the African Development Bank Group (AfDB), Dr. Akinwumi A. Adesina was awarded an Honorary Doctor of Letters (Honaris Causa) of Makerere University. The honour was in recognition of his distinguished contribution to Science, research and academic leadership; reform and thought leadership; catalysing Africa's social and economic progress; partnerships, networks and advocacy for development. The award ceremony was presided over by the Chancellor, Prof. Ezra Suruma at the fifth and last session of the Makerere University 71st Graduation Ceremony held on 21st May 2021 in the University Freedom Square.

Makerere University Chancellor, Prof. Ezra Suruma; Chair Council, Mrs Lorna Magara; Vice Chancellor, Prof. Barnabas Nawangwe; with Dr Akinwumi A. Adesina after the award ceremony

Table 5: Successful PhD defences

NO.	SCHOOL OF AGRICULTURAL SCIENCES
1.	Mr. Christopher Mawa
2.	Mr. Kalule Wamala Stephen
3.	Ms. Ruth Wilhem Mukhongo
4.	Mr. Aben Charles
5.	Mr. Akatwijuka Rogers
6.	Mr. Alfonse Leonard
7.	Mr. Fred Kalanzi
8.	Mr. Khalid Elsiddig
9.	Mr. Komakech Alfred
10.	Mr. Okii Denis
11.	Mr. Robert Muzira
12.	Mr. Sulaiman Ndaula
13.	Mr. Tonny Obua
14.	Ms. Astere Barabyenga
15.	Ms. Getachew Shambel
16.	Ms. Jane Alexander N. Ruley
15.	Ms. Lucy Mulugo
16.	Ms. Martina Kyallo

NO.	School of Forestry, Environmental and Geographical Sciences
1.	Mr. Hannington Ochieng
2.	Ms. Antonia Nyamukuru
3.	Ms. Caroline Aboda
4.	Ms. Catherine Mulinde
NO.	**School of Food Technology, Nutrition and Bio-Engineering**
1.	Mr. Joseph Balamaze

vi) Introducing CAES First Year Students to MUELE

On 24th February 2021, officials from the Makerere University Institute of Open, Distance and e-Learning (ODEL) introduced over 500 First Years students from the College of Agricultural and Environmental Sciences (CAES) to MUELE.

Students who turned up for the training

vii) MUARIK Field Day

The College of Agricultural and Environmental Sciences (CAES) on 6th February, 2021 held a Field Day to mark the end of the Recess term at the Makerere University Agricultural Research Institute Kabanyolo (MUARIK). The recess term involved students from four programmes namely; BSc Agriculture, BSc. Horticulture, BSc. Food Science and Technology, and Bachelor of Rural Innovations (BARI) External. Previously, the College has been conducting recess term at MUARIK for the first three programmes without BARI External. From 2021, and moving forward BARI External has been integrated into the recess term because the programme has very limited time to have face to face interaction with the instructors. According to the CAES Management, the four years were not sufficient for BARI External students to cover everything.

Students on the Hydroponics and Smart Greenhouse tomato production showcasing their products.

Students on pasture seed enterprise presenting their work

Students on the dairy enterprise presenting

viii) 244 Ugandan University students for AgroStudies Internship in Israel

244 students from five universities- Makerere, Kyambogo, Gulu, Busitema and Bishop Stuart University were flagged off to Israel for a one-year paid internship. Out of 244, 10 were female. The students were flagged off by the Vice Chancellor of Makerere University represented by his Deputy in charge of Finance and Administration (DVC F&A), Dr Josephine Nabukenya on 13th October, 2021 at a colourful ceremony held at the Central Teaching Facility 2 at Makerere university. The function was also attended by a team from the AgroStudies centre in Israel led by the CEO Mr. Yaron Tamir, representatives from the participating Universities in Uganda, the Principal, College of Agricultural and Environmental Sciences (CAES), alumni and coordinators of the AgroStudies Apprenticeship Programme from the five universities. Prior to the flag off, the AgroStudies CEO, Mr. Yaron Tamir and his deputy paid a courtesy call on the Vice Chancellor where they discussed matters of interest to the university and the Government of Uganda especially a plan to start an AgroStudies Alumni Cooperative in Uganda and the possibility of the programme alumni to support government in providing extension services.

The AgroStudies cohort 2021/2022 was organized under the theme, **"Securing the Future Uganda through Agriculture Capacity Building".** At Makerere University, the programme was coordinated by Dr. Mildred Ochwo-Ssemakula and Dr. Narisi Mubangaizi from the School of Agricultural Sciences. The students' participation in the AgroStudies agriculture capacity building programme is a response to the need to transform from subsistence to more commercial agriculture in a bid to secure the future of Uganda.

Above: Acting Vice Chancellor, Prof. Josephine Nabukenya delivering her remarks during the function

Below: Acting Vice Chancellor Prof. Josephine Nabukenya flagging off the 244 students to Israel

ix) Department of Agricultural Production Field Trip

Academic field trips form an important component in the curriculum of Third Year students of Bachelor of Sciences in Agricultural Land Use and Management. The trips expose students to landscape management challenges and build their capacity in diagnosing field problems common among the farmers. The annual field trip mainly focuses on Land Use Planning, Land Use Impact Assessment and Soil Productivity Assessment. However, other related courses such as soil and water conservation, waste management, soil and water pollution, soil fertility, and pedology are described during the trip. The Master of Science in Soil Science students take lead in the collection of geo-referenced soil samples, soil survey, soil profile description and classification along different landscape positions. At the end, the MSc Soil Science group overlays geo-referenced soil information on to old soil maps, in their field reports. With support from the University, the Department of Agricultural Production, School of Agricultural Sciences, College of Agricultural and Environmental Sciences (CAES) conducts annual field trips for third year students of Bachelor of Science in Agricultural Land Use and Management and Bachelor of Science in Agriculture IV (Soil science option). The Department also conducts field trips for Master of Science in Soil Science and Master of Science in Integrated Watershed Management students. The trip contributes 40% of the total final exam assessment. In the course of the trips, students are furnished with practical knowledge on: (i) the state of land use as well as soil and water quality on major croplands and catchments; (ii) the impact of land use and land use changes on natural resource quality and social-economic development; (iii) potential drivers of changes in the land use and water resource quality over years and the best management interventions for sustainable use; (iv) rangeland use and management-opportunities and challenges; (v) the processes involved in management of large-scale farms/projects; and (vi) the spatial physical planning approaches, the associated challenges and the possibility for re-planning and restoration of the degraded ecosystems.

The 2020/2021 Field Trip

The trip for the 2020/2021 Academic Year had been planned for Kumi, Soroti, Katakwi and Moroto districts but was re-planned to nearby places due to time constraints caused by the COVID19 lockdown restrictions and insecurity in Karamoja. The trip was conducted in Mpigi, Masaka and Sembabule districts between 8th-13th November with the overall aim of exposing students to the practical challenges and opportunities that exist in the use and management of soil, water and wetlands. This particular study involved characterizing and mapping of selected landscapes using a GPS; studying maps and ground truthing land use changes; making field observations and conducting interactive discussions with local guides and lecturers; soil and water sampling; solid waste sampling; and sediment sampling.

Key outputs/Key results:

- Students were able to develop land use maps of some catchments
- Students carried out soil suitability assessment across the visited districts
- Land management options were proposed by staff and students
- The Students collected 50 soil samples and 20 water samples for their special projects

• The impact assessment of sand mining at Lwera on the environment was performed and sustainability plan was proposed

• Photos were captured and video clips recorded to aid teaching

• Project Coordination: The trip was coordinated by Dr Emmanuel Opolot. It was attended by several members of staff from the Department of Agricultural Sciences namely: Dr Twaha Basamba Ateenyi, Dr Giregon Olupot, Dr Patrick Musinguzi, and Dr Isaac Newton Alou.

Site visit to assess soil degradation and soil sampling at one of the murrum-mining sites along Mpigi-Masaka Road

Students and staff at the sand mining site to understand the entire process and the potential impacts of sand mining on the environment

A farmer presenting to staff and students how he uses a frame to delineate points for construction of retention ditches and contour bunds for soil and water conservation

RESEARCH AND INNOVATIONS

i) Research projects

Table 6: Ongoing Research Projects

No.	Project title	Principal Investigator	Amount	Funder	Timeframe
1.	Makerere University and Cukurova University Research collaboration	Prof. Isa Kabenge	USD2,000,000 per year for three years	Government of Uganda and Turkey	July 2019 -July 2022
2.	ARUA Water Centre of Excellence	Prof. Isa Kabenge	USD250,000	Rhodes University and ARUA-UKRI GCRF Partnership Programme	May 2019-May 2024
3.	Making Potato Value Chain Enhance Productivity and Incomes in Uganda	Prof. Johnny Mugisha	USD350,000	MasterCard Foundation through RUFORUM	2018-2022
4.	Policy and Regulatory reform options for seed market development: Expanding the empirical evidence base in Uganda	Dr Fredrick Bagamba Co-PI	Euros28,325	NOW-WOTRO	2019-2022
5.	Combating Arthropod Pests for better Health, Food and Climate Resilience	Dr Rosemary Isoto Emegu Co-PI	USD22,211	ICIPE	2019-2023
6.	Implementation of Annual Agriculture and Market Support Household surveys in the framework of WFP CSP UG 01	Prof. Bernard Bashaasha	USD100,000	WFP	2020-2024

7.	Market-assisted Breeding of Selected Native Chickens in Mozambique and Uganda (MAB-Chicken Project)	Dr Donald Kugonza Rugira	USD1,248,326	African Union AURG-II/2/2018	2019-2022
8.	Improving Pig Productivity and Incomes through an Environmentally Sustainable and Gender Inclusive Integrated Intervention Package (More Pork Project),	Dr Donald Kugonza Rugira		International Livestock Research Institute (ILRI) - CRP001113	
9.	Reversing under-five child malnutrition: multidisciplinary innovations to improve free-range chicken production and consumption	Dr Donald Kugonza Rugira		GoU & Makerere University Research and Innovation Fund - MAK RIF2/ CHUSS/015	
10.	Genetic Characterization of Cattle Populations for Optimized Performance in African Ecosystems (OPTIBOV)	Dr Donald Kugonza Rugira		European Union (EU) & Ministry of Science, Technology & Innovation (MoSTI) - LEAP-AGRI-326	
11.	Participatory Pathways to Sustainable Intensfication (PASUSI)	Dr John Baptist Tumuhairwe	USD228,000	EU/Government of Uganda under LEAP-agri-consortium	2019-2023
12.	Partnership for Training Scientists in Crop Improvement for Food Security in Africa (SCIFSA)	Dr Thomas Odong Lapaka	Euros 1,398,975	European Commission Grant	2017-2022
13.	Regional academic exchange for enhanced skills in fragile ecosystems management in Africa (REFORM)	Dr Frank Kansiime Co-PI	Euros 44,439.6		2017-2022

14.	Speciation Clock	Dr Gerald Eilu - Collaborator	USD2,400	Research Council of Norway	2018-2022
15.	ANTENNA: Norwegian-African network for training a new generation of entomologists in DNA-based molecular methods	Dr Gerald Eilu - Partner	USD700,000	SIU/DIKU (Norwegian Agency for International Cooperation and Quality Enhancement in Higher Education)	2019-2023
16.	Making Potato value chain enhance productivity and incomes in Uganda	Dr Abel Atukwase Co-PI	USD350,000	MasterCard Foundation	2018-2022
17.	Unlocking the Potential of Smallholders for Urban Food System Resilience in Uganda.	Dr Frank Mugagga	$130,000	SIDA under Phase II of AgriFoSe2030 Programme	2021-2023
18.	Capacity Building for Socially Just and Sustainable Energy Transitions.	Dr Frank Mugagga Co-PI	NOK20M	Funded by NORAD under NORHED II Programme (Energy Sub programme)	2021 – 2026
19.	Explaining inclusive lower-level urbanization in Tanzania and Uganda.	Dr Frank Mugagga Co-PI	$120,000	Funded by SIDA, Sweden	2021-2023
20.	National Research and Innovation Program (NRIP)	Dr. Emmanuel Opolot	USD 75,000	Government of Uganda, through the Ministry of Science, Technology and Innovation	2021-2022
21.	Future Leaders African Independent Research (FLAIR) Fellow.	Dr Emmanuel Opolot	£288,333	This fellowship is supported by the Royal Society in collaboration with the African Academy of Sciences	2020-2022

22.	Gender Research Capacity Building/ Gender Responsive Researches Equipped for Agricultural Transformation (GREAT II)	Dr Margaret Najjingo Mangheni	$ 876,345	Bill and Melinda Gates Foundation (BMGF) through International Livestock Research Institute	May 2021 – Dec 2022
23.	Borlaug Higher Education for Research and Development (BHEARD)	Dr Jackline Bonabana	USD384,014	United States Agency for International Development (USAID)	2020 - 2022
24	Partnership for Training Scientists in Crop Improvement for Food Security in Africa – SCIFSA	Dr. Odong Thomas	Eur 1,398,975	European Union	2018 -2023
25.	Improving Essential Oil Feed-stocks and High-value Products from Mentha Spp to benefit Local Uganda Economies (MENUE)	Dr. Ivan Mukisa Muzira	£ 79,099	Cardiff University from BBSRC-GCRF-IBBE UKRI	2020 - 2023
26.	Foodland	Dr. Isa Kabenge	Eur 6,999,086.75	European Commission	2020 - 2024
27.	Locally-driven Co-development of Plant-based Value Chains Towards More Sustainable African Food System with Healthier Diets and Export Potential - InnoFood Africa	Assoc. Prof. Yusuf Byaruhanga	Eur 280000	European Commission	Sept 2020 – Sept 2025
28.	Fruits & Vegetables for All Seasons (FRUVASE)	Prof. Archileo Kaaya	Eur 143,374.91	Federal Ministry of Food & Agriculture, Germany	Oct 2018 – Dec 2022
29.	IGAD - GMES & Africa / ICPAC Project	Prof. Bernard Bashaasha	Eur 120,000.00	IGAD Climate Predictions & Applications Centre	Aug 2019 - Dec 2022

30.	Water Spoutt Royal College	Prof. Muyanja Charles	EUR 200,000.00	Horizon 2020	June 2016 - June 2022
31.	Evaluation of the Strategic Intervention for Animal Genetic Improvement Project (SAGIP)	Prof. Johnny Mugisha	UGX 534,980,000	National Animal Genetic Resource and Data Bank of Uganda	Nov 2020 – October 2023
32.	ILRI - Makerere University - Community Based Artificial Insemination – CBAI Pilot Project	Dr Donald Kugonza	USD 84,534	International Livestock Research Institute	2021 - 2022
33.	Achieving the SDGs in East African Drylands: drylands transform	Dr Denis Mpairwe	USD 97,969.08		
34.	Improving Essential Oil Feedstocks and High-Value Products from Mentha SPP to Benefit Local Uganda Economies (MENUE)	Dr. Ivan Mukisa Muzira	USD108,088.51	Cardiff University from BBSRC - GCRF - IBBE UKRI	
35.	Sustainable Off grid Solutions for Pharmacies & Hospitals in Africa – SoPHIA Project	Dr. Nicholas Kiggundu	EUR421,187.5	European Climate, Infrastructure and Environment Executive Agency (CINEA)	1st Oct 2021 – 30th Sept 2025

Table 7: Projects won by CAES staff in Round 3 of Mak-RIF

No	Research Topic	Principal Investigator
1.	Building Soil Tolerance Thresholds to Reduce Degradation and Enhance Agricultural Productivity in Marginal Highland landscapes of Uganda	Twaha A Basamba
2.	Improving Livelihoods of Small-Scale Producers in Uganda Through Digital Advisory Services	Richard Edema
3.	Estimating intake of cattle grazing heterogeneous pastures using Near Infrared Reflectance spectrophotometry (NIRS) for improved nutrition management and productivity of pasture-based systems (HEPANUT project)	Idibu Joachine
4.	Developing aquaculture systems for Mukene for increased food security and income	Margaret Nabasirye
5.	Towards improved coffee-farm yields by synchronising coffee tree flowering habit amidst a changing climate in Uganda	Anthony Mwije
6.	Harnessing chimpanzee ecotourism for enhanced conservation and improved livelihoods in Uganda	Amos Ochieng
7.	An innovative e-community governance model for monitoring implementation of catchment restoration and management interventions in River Rwizi sub catchment	Dr. Patrick Musinguzi
8.	Improving access to biodiversity data for conservation decision making: A case of the National Biodiversity Data Bank, Makerere University, Uganda	Daniel Waiswa
9.	Revamping and commercialization of Agricultural Engineering Workshop at MUARIK	kivumbi Hussein Balimunsi
10.	Deployment of the new Maksoy soybean varieties for on-farm income enhancement, Food and Nutrition security, Enterprise Development and Job creation in Eastern Uganda	Phinehas Tukamuhabwa
11.	Farm Forestry intervention for increased Crop Productivity and livelihood resilience to climate variability in Eastern Uganda	Gorettie Nabanoga
12.	Enhancing Value addition on Potato-Sorghum enterprises for Improved Livelihoods in Uganda (EVaPoSIL)	Johnny Mugisha
13.	Empowerment of the Agro-Processing Industry to meet the Quantity and Quality Standards for the Local and Export Market; a Programme Enhancing the Practical Skills of Students in Makerere University	Julia Kigozi

ii) Research dissemination

Mak-RIF, CAES Open Day

The College of Agricultural and Environmental Sciences (CAES) in collaboration with Makerere University Research and Innovations Fund (Mak-RIF) held an Open Day on 14th December 2021 to showcase outputs of the projects supported by Mak-RIF and other research projects at the College. The event was presided over by the Permanent Secretary, Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), Maj. Gen. David Kasura Kyomukama. It was attended by, among others, the Vice Chancellor, Makerere University, Prof. Barnabas Nawangwe, the representative of the Chair Grant Management Committee, Prof. Isa Kabenge; stakeholders in the agricultural sector; the Principal, CAES, Prof. Bernard Bashaasha; the Deputy Principal, Dr.Gorettie Nsubuga Nabanoga; members of the Mak-RIF Secretariat led by Ms. Phoebe Kamya Lutaaya; and members of staff and students of Makerere University.

Projects showcased;

1. Unlocking the commercial potential of Canarium schweinfurthi (Empafu) indigenous fruits for improved livelihood in Central Uganda – Prof. Jacob Agea. The main objective of the project was to develop high value commercial innovations from the fruit. Specific objectives were to formulate high value wine and jam innovations from the fruit pulp and to assess consumer market acceptability for developed wine and jam innovation.

2. Design, construction and evaluation of an automated continuous pasteurizer –Dr Emmanuel Baidhe, Dr Julia Kigozi. Along the juice processing chain, thermal processing by pasteurization is considered to be the most crucial of all unit operations as it increases the shelf life of the juice. Several batch pasteurizers have been locally developed and adopted. However, with the batch system, a particular volume of product is processed per unit time. It is therefore very cumbersome for a processor with large volumes since they have to keep emptying and refilling the vat. It requires a lot of resources in terms of labour (Amit et al., 2017), time and energy to have large quantities of juice processed. The purpose of the study was to design, simulate, construct and assess the performance of the low-viscous juice continuous pasteurizer.

3. Enhancing Value addition on Potato-Sorghum enterprises for Improved Livelihoods in Uganda (EVaPoSIL) -Prof. Johnny Mugisha. Potato (Solanumtuberlosum) and sorghum (Sorghum bicolar) are potential pathways for enhancing household incomes, food and nutrition security in South-western Uganda which is characterized by land scarcity, decreasing agricultural productivity, high post-harvest losses and low per-capita income. Potato and sorghum are the region's main enterprises but their economic and nutrition potential are not fully exploited. Sorghum productivity and profitability are very low and potato harvest losses in form of non-marketable tubers are high. The project sought to enhance the value of both crops by innovative value addition that makes them complements, reduce harvest losses, increase incomes, and make available to consumers a diversity of high quality products. The overall objective was to improve the economic value of potato and sorghum enterprises for improved livelihoods of the value chain actors.

4. Developing dry season feeding technologies for different cattle production systems in Uganda – Dr Justine Nambi-Kasozi. Scarcity, high cost and fluctuating quality of feeds are major constraints to sustainable cattle production in Uganda, particularly during the dry seasons. Use of crop residues plays an important role in reducing feed stress. However, most crop residues are bulky and low in nutrient content hence unable to support maintenance and production requirements of cattle. The objective of this project was to develop crop residue-based multi-nutrient blocks (MNB) and pellets to increase the intake and utilization of crop residues for dry season feeding.

5. Digitalizing the Makerere University Soil Test Kit for rapid soil assessment, improved soil management, crop yields and incomes among farmers in Uganda – Emmanuel Opolot. Accurate assessment of soil is key for its sustainable use and management. The Makerere University Soil Test Kit (MAK-STK) comes in handy. It gives results of five soil parameters (pH, N, P, K and SOM) within minutes. However, the results from the MAK-STK are qualitative and thus hard for agricultural extension workers to advise farmers on how much nutrients to add to the soil. The project

objectives were to (i) calibrate the MAK-STK with laboratory data for major soil types in Uganda, (ii) develop a digital platform through which the MAK-STK results can be quickly and easily translated to fertilizer recommendations and (iii) build capacity of the agricultural extension officers, farmers and fertilizer input dealers on the use of the Makerere University Soil Test Kit and its digital platform.

6. Development of a Safe and Efficacious Anti-malarial drug from Traditional medicine -Prof. John Tabuti. Malaria is still a leading source of illness and death. In 2017, about 219 million suffered from malaria worldwide, with 92% of cases occurring in Africa. Malaria management is complicated by the fact that access is still limited in some places, and there is a possibility of treatment resistance.The goal of this research was to contribute to the development of a safe and efficacious anti-malarial. The specific objectives were: to compile a list of malaria treatment plants in Tororo District and prioritize them to determine the safety of the malaria treating plants.

7. Deployment of the new Maksoy soybean varieties for on-farm income enhancement, Food and Nutrition security, Enterprise Development and Job creation in Eastern Uganda – Prof. Phinehas Tukamuhabwa. Over the last 20 years, Makerere University developed six improved soybean varieties namely MAKSOY 1N, 2N, 3N, 4N, 5N and 6N. Unfortunately, the potential of the new MAKSOY soybean varieties had not been fully exploited due to limited farmer access to seed in addition to low skill set in soybean agronomic practices that subsequently leads to low yields. Further, each of the soybean varieties has specific attributes for protein, oil, maturity and yield in the field and efforts had been made to enhance their adoption in different parts of Uganda. However, the role of soybean in contributing to food and nutrition security of different households and communities in the country remains a critical challenge. This project focused on harnessing the value of the different soybean varieties through value addition using soymilk and soy flour for adoption by households, SMEs and also to set up a Soy Processing Unit at MUARIK.

8. Improving access to biodiversity data for conservation decision making: A case of the National Biodiversity Data Bank, Makerere University, Uganda – Dr. Daniel Waiswa. This project sought to revitalize the NBDB as a one-stop biodiversity data centre enabling easy and fast access for sound biodiversity conservation decision making. The overall objective was to improve access to biodiversity data for conservation decision making while the specific objectives were to: increase stakeholders' engagement and confidence in the NBDB for enhanced biodiversity data sharing and access, re-designing and operationalizing the NBDB Database for reception, storage and open access to data and enhancing and sustaining the staffing, capacity and infrastructure of the NBDB.

9. A Pedal-Operated Seed Cleaner (PoS-Cleaner) To Boost Post Harvest Grain & Legume Quality, Increase School-Study time & Create Financial Freedom in Rural-Uganda – Dr. Peter Tumutegyereize. Sub-Saharan Africa (SSA) annually registers 40-50% of food Post-Harvest Losses (PHLs) worth US$4 billion with 41% and 26% respectively grains & legume losses in Uganda. Maize grains lost alone, could feed over 1.14 million persons for a full year. These losses along the food chain are greatly attributed to poor seed sorting or cleaning. Unclean seeds and foreign materials promote mold development resulting to dry matter loss, nutritional changes, seed quality loss, aflatoxin contamination and PHLs during storage and processing. Despite this, majority of small-scale farmers have no access to appropriate seed cleaning technologies. The available imported seed cleaners in Uganda are energy and cost demanding in terms of ownership, operation and maintenance. Farmers depend on traditional screening or winnowing which is inefficient, time consuming, labour intensive and dust exposure resulting into ill health. For rural schools that depend on in-kind food tuition contributions from parents, students traditionally clean seeds hence reducing their study time and educational performance. The study sought to create intermediate but appropriate post-harvest cleaning technologies.

10. Developing an automatically controlled commercial solar-dryer and efficient resource recovery innovations for sustained market responsive fruit production in Uganda -Dr. Ahamada Zziwa. Food insecurity and poor livelihoods continue to prevail in Uganda partly due to high post-harvest losses, limited value addition options and low farm-gate prices particularly for perishable foods (FAO, WFP and IFAD, 2019). The lack of affordable preservation options contributes to over 30% post-harvest losses because majority of farmers have no access to electricity for processing and preserving perishable foods. Harnessing solar energy and its use for food preservation is a viable option for most off-grid farmers. However, the existing solar dryer designs are limited in drying efficiency due to

absence of temperature and relative humidity controls which undermines their ability to ensure consistent physical and nutritional quality of dried products. Most dryers are also small drying capacity designs based on only solar light as the drying power which renders them unsuitable for large scale drying and uneconomical (Shaikh and Kolekar, 2015). The project aimed to: 1)design, construct, test and promote a sensor-controlled dual heat source (Hybrid) solar dryer to ensure consistent drying of reasonably large volumes of perishable produce; 2) investigate vermicompost recovery from pineapple waste and cow dung; and 3) optimise biogas production from pineapple waste.

11. Development of Nutrient-Dense Recipes and Products from Underutilized Crops to Alleviate Malnutrition among HIV/AIDS Infected Persons in Western Uganda – Dr. Agnes Nabubuya. Human Immunodeficiency Virus (HIV) is a global pandemic that is currently affecting 3.7 million people worldwide of which 70% is found in Sub-Saharan Africa. Uganda continues to suffer from scourge of HIV with current prevalence at 7%. Healthcare of people living with HIV/AIDS (PLWHA) in Uganda is constrained by poor nutrition, with estimates of 25% suffering from malnutrition. This project addressed the challenge of malnutrition in PLWHA by using underutilized crops through development of nutrient-dense recipes and products. The research team analysed the nutritional composition of identified underutilized crops and developed nutrient-dense recipes and products for PLWHA.

12. Strengthening the resilience and visibility of peri-urban poultry farmers in Wakiso for better marketing and profitability through feeding, post-harvest handling, value addition and resources recovery – Dr. Ahamada Zziwa. Globally, COVID-19 has had adverse impacts on the poultry value chain through infecting workers, farmers, stalling production, disrupting the supply chain, and thus affecting product demand. The lockdown led to socioeconomic restrictions and distortions in community dynamics, marketing and sale of products leading to huge losses in the poultry sector (FAO, 2020; Poudel et al., 2020). Transport restrictions to poultry farmers and closure of national borders, weekly markets, institutions, schools, hotels and restaurants, which were the main markets, left farmers with large quantities of unsold poultry products, resulting in financial losses especially to farmers without value-addition options and resources recovery innovations. The overall objective of the project was to strengthen the resilience and visibility of peri-urban poultry farmers for sustained poultry production, better marketing and enhanced profitability through innovative feeding, post-harvest handling, value addition and resources recovery.

13. Optimized software for planning and simulation of food aid response during the COVID-19 pandemic and other similar disasters in Uganda – Dr. Fildah Ayaa. Covid-19 was declared a pandemic on 11th March 2020. First lockdown measures to contain the spread of the virus effected on 31st March 2020. Covid-19 lockdown disrupted food supply systems, causing food insecurity, especially in urban areas.Uganda's government food distribution efforts were frustrated by poor planning for both food stock and manpower. Only 12 % of the total population received food aid during lockdown period. Of these, 24% were urban residents and only 7% lived in rural areas (Acayo,2020). The research team designed software for authorities to plan for food distribution during and after the Covid-19 pandemic in Uganda.

14. Development of a Green Low Cost Touchless Handwash Technology (TW-20 Kit) For Public Shared Spaces – Dr. Joshua Wanyama. Effective hand washing with soap for at least 20 seconds and limiting contacts are useful COVID19 preventive measures. However; the existing point-of-hand washing systems are ineffective in achieving the set measures as most of them require individuals to touch the units, have no mechanism in place to ensure hand washing with soap for the recommended time and are therefore prospective contagion points for the pandemic (WHO 2020). There was therefore, a need to develop a low-cost hand washing technology that automatically releases soap detergent

without contact and allows users to rub and scrub the hands with soap for 20 seconds before water is released for rinsing. The project aimed to provide a safe water and hygienic technology to boost behavioural hand washing culture and reduce the risk of SARS-COV-2 human to human transmission in public shared spaces. The specific objectives were: i) to re-evaluate and modify the first prototype of TW-20 Kit V1.1 design customized for public settings, ii) to influence public behavioural change towards hand hygiene and product validation by undertaking a comprehensive pilot study in selected shared public spaces in Kampala Metropolitan Area.

15. Design and development of an atomized spray drier for egg powder production for use in bakery industries of Uganda – Dr. Kivumbi Hussein Balimunsi. Due to the introduction of fast growing breeds of chicken in Uganda, there has been enormous production of high quality eggs, making the country one of the largest egg producers in the region. However, due to the outbreak of COVID19 and the subsequent lockdowns, the prices of eggs drastically reduced to nearly 5000 UGX per tray consequently affecting chicken farmers. This was further worsened by the lack of value addition to the available eggs leading to huge losses. This project sought to explore the utilization of spray drying in the production of high-value products from eggs in Uganda as a measure to minimize losses.

16. Automation of communal hand water pumps to eliminate COVID-19 transmission – Dr. Nicholas Kiggundu. The research was motivated by the observation that alternative solutions of limiting the spread of COVID-19 such as washing hands with water and soap or use of chemical sanitizers are difficult to enforce especially in the low income rural and peri-urban communities where the boreholes are found. The researchers invented MAKNAI an acronym for the Makerere University – MAK NAyIkondo – vernacular for borehole, a prototype to automate cranking of the hand pump that draws water from a well. Designed by a team from the Department of Agricultural and Biosystems Engineering (DABE), School of Food Technology, Nutrition and Bioengineering (SFTNB), College of Agricultural and Environmental Sciences (CAES) the prototype consists of a PV (photovoltaic) panel, battery, solar charge controller, inverter, motor, pulleys, belt, reciprocating arm and a foot switch. The foot switch serves to replace the use of palms and fingers to crank the pump handle, as is the practice while drawing water at boreholes.

17. Empowerment of the Agro-Processing Industry to meet the Quantity and Quality Standards for the Local and Export Market; a Programme Enhancing the Practical Skills of Students in Makerere University – Dr. Julia Kigozi.

18. Mountain Gorilla Tourism Re-examined: Implications of increased visitor numbers to the welfare and behaviour of mountain gorillas in Bwindi Impenetrable National Park, Uganda – Prof. David Mwesigye Tumusiime.

19. Developing Biofertiliser Formulations to Unlock Crop Productivity for Improved Food Security and Household Livelihood in Uganda – Dr. John Baptist Tumuhairwe.

Prof. Jacob Agea (L) shows off outputs of his research project

Prof. Johnny Mugisha's project aimed to enhance the value of potato and sorghum

Prof. Phinehas Tukamuhabwa (2nd R) showcasing improved soybean varieties

A Masters student (L) showcasing a machine he invented to aid soap processing

A team of researchers headed by Dr. Dorothy Nakimbugwe created alternatives for the common wheat flour using amaranth for improved nutrition

The Vice Chancellor, Prof. Barnabas Nawangwe and Guest of Honour, Maj. Gen. David Kasura Kyomukama touring the exhibition stalls

Dr. Nicholas Kiggundu (L) invented the MAKNAI to safeguard the spread of COVID19 at boreholes

Research workshop: Impact of pathogens on Agricultural production

Agriculture is the backbone of Uganda's economy, employing about 73% of the population and contributing approximately 20% of the country's Gross Domestic Product (GDP) and 48% export earnings. The National Development Plan (NDP III) identifies agriculture as one of the key growth opportunities with the highest potential to generate employment and have positive multiplier effects on other sectors. The Agricultural sector contributes about 50% of the gross domestic product (GDP) of most countries in Africa, and plays a pivotal role in ensuring food security across the globe. The sector is however derailed by a number of factors. Key among these are pathogens that are greatly undermining crop production in the country and Africa in general.

On 8th-9th November 2021, the Department of Agricultural Production, College of Agricultural and Environmental Sciences (CAES), Makerere University in partnership with the University of Pretoria, South Africa held a research dissemination workshop at Golf Course Hotel, Kampala to deliberate on a number of issues affecting the sector. Convened by Dr Nicholas Kagimu under the theme "The Impact of Pathogens on Agricultural Production", the workshop was part of the activities under the Future Africa's Early Career Research Leader Fellowship (ECRLF) programme at the University of Pretoria intended build a critical mass of the next generation researchers in Africa. It drew participants from academic and research institutions across Africa.

Topics discussed included; the Status of nematology research in Uganda by Dr. Hebert Talwana (Department of Agricultural Production, CAES); Bioprospecting of the Natural Products from Xenorhabdus and Photorhabdus bacteria and their application in agriculture by Dr Nicholas Kagimu (ECRL Fellow at Future Africa, University of Pretoria); Entomopathogenic fungi for insect crop management by Dr Jeninah Karungi (School of Agricultural Sciences, CAES); An overview of Entomopathogenic nematodes- EPN (insect-killing-worms) in Africa/ICIPE perspective presented by Dr Solveig Haukeland, ICIPE Nairobi); Status of liquid culture development for commercialization of entomopathogens in South Africa (Prof. Antoinette Malan, Stellenbosch University); Forest pest surveillance to protect Africa's forest resource (Prof. Brett Hurley, FABI – University of Pretoria); Bio-control agents in pest management in Uganda's forest systems (Dr Peter Kiwuso – NaFORRI); Bio-prospected products from insects (pharmaceutical, nutritional, cosmetics) presented by Dr Alice Nabatanzi, College of Natural Sciences – Makerere University; Chemical defenses of forest trees to fungal infection and the consequences of these defenses on insect herbivory (Prof. Almuth Hammerbacher – FABI, University of Pretoria); What Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria can offer in collaboration with research and industry in Uganda (Prof. Bernard Slippers – Director FABI, University of Pretoria; Tsetse fly vector: effects distribution and control in Uganda; Tick epidemic and vaccine development; Helminths and helminths control in small ruminants (Dr Idibu Joachine –CoVAB, Makerere University); Veterinary drug use and resistance; Potential of biopesticides in small holder agricultural systems (Dr Paul Sigombe – Real IPM Uganda); as well as Chemical control of internal and external parasites in livestock by Dr Ivan Kisakya from MTK Uganda. In their discussions, the researchers highlighted the different challenges affecting agriculture across Africa and the extent of the damage caused by pathogens to plants and humanity. Besides other challenges, the researchers noted that pathogens were causing a serious economic threat, calling for various interventions to eliminate them.

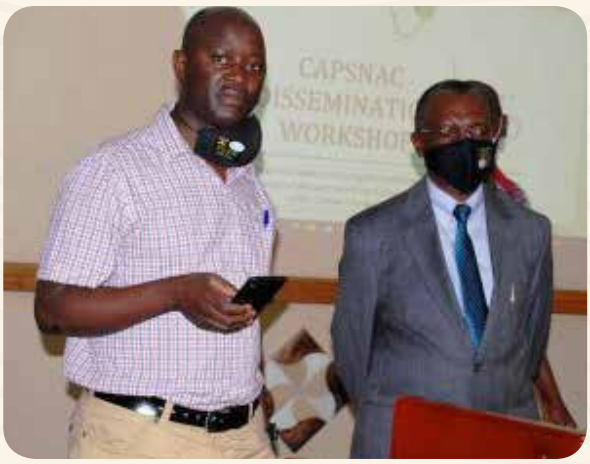
Left: The Workshop Convener, Dr. Nicholas Kagimu addressing participants.
Right: Dr. Herbert Talwana called for more funding towards nematology research

Prof. Cheikh Mbow, Director FutureAfrica in a discussion on research collaborations

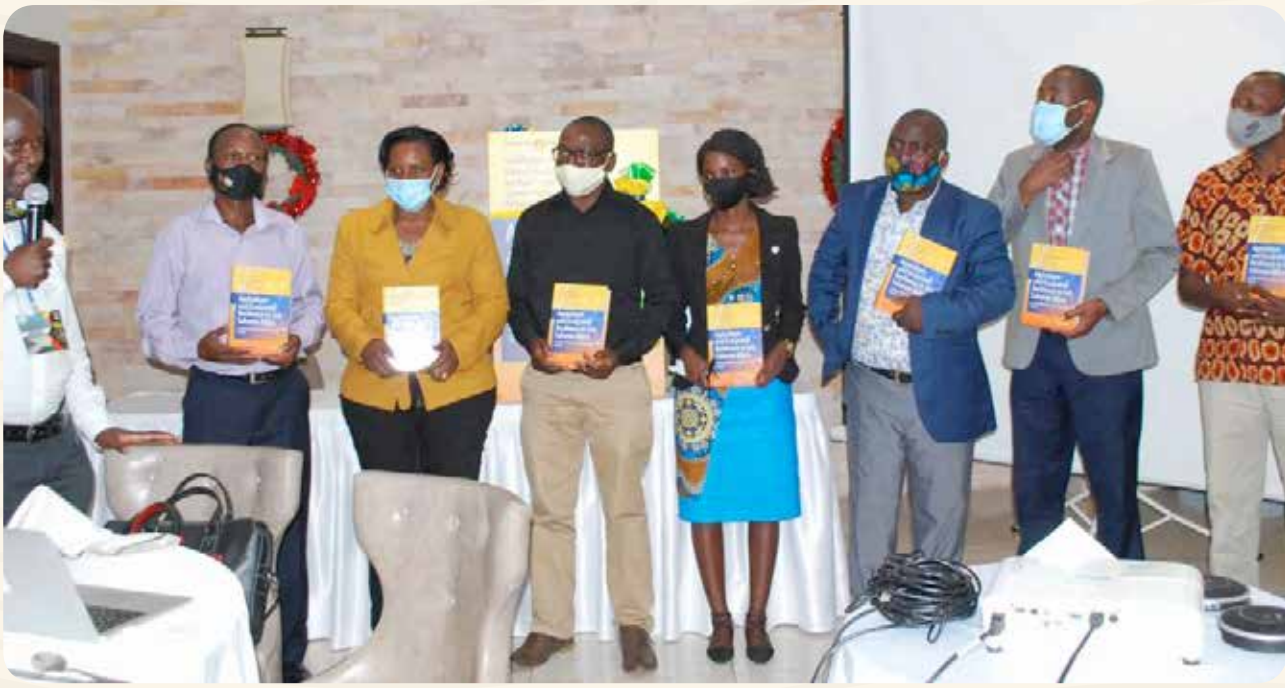
iii) Research activities

Book Launch

Makerere University on 4th December 2020, launched a book titled, "Agriculture and Ecosystem Resilience in Sub Saharan Africa". The book is one of the outputs of the project titled **"Regional Capacity Building for Sustainable Natural Resource Management and Agricultural Productivity under Changing Climate"** (CAPSNAC). CAPSNAC is a collaborative project involving four institutions, one in the North and three in the South. These include; Makerere University-Uganda, Addis Ababa University-Ethiopia; University of Juba-South Sudan; and Norwegian University of Life Sciences-Norway. Makerere University is the lead institution, and the project is based in CAES, with Prof. Samuel Kyamanywa, as the Principal Investigator (PI). It was funded by NORAD through the NORHED programme to a tune of NOK20 million. The book was edited by Assoc. Prof. Yazidhi Bamutaze as the Lead Editor, Prof. Samuel Kyamanywa, and Dr Gorettie Nabanoga from Makerere University. Others from partnering institutions were Prof. Bal Ram Singh and Rattan Lal.



Left: Assoc. Prof Yazidhi Bamutaze and Pro.f Samuel Kyamanywa, steering and co-steering members.
Right: DVCAA Dr. Umar Kakumba signs on the dummy



Some of the partners at the book launch

2nd Policy Seminar on Rural Development

With support from the Makerere University Research and Innovation Fund (MAK-RIF), the College of Agricultural and Environmental Sciences (CAES) held the 2nd policy seminar on Rural Development. The seminar held at the School of Food Technology Nutrition and Bio-engineering was conducted under the topic; **Agro Industrialisation in the context of Rural Development in Uganda.** Officiated by the former Agriculture Minister Dr. Kisamba Mugerwa (RIP), the seminar was attended by Researchers, policy makers and advisors across the country. The presenters included Martin Fowler, the Senior Agricultural Adviser USAID Uganda, and Jacob Rauschendorfer, the Country Economist, Bank of Uganda and also at the International Growth Centre. In their presentation titled, **"The Current Status, Future Prospects and Possible Solutions to Pressing Challenges"**, Martin Fowler and Jacob Rauschendorfer observed that COVID-19 had a great impact on Uganda despite the continuity of agricultural services during the lockdown.

According to the presentation, the outbreak of the COVID-19 pandemic and subsequent lockdown led to a reduction in turnover and sales of 30% seeds, fertilizers, agrochemicals and vet drugs. The supply of raw materials to processors from out-growers was equally affected. SMEs were not spared either yet they contribute significantly to the country's development. In the recommendations, the presenters called for; (1) Rationalisation and prioritisation of the value-chains that are to form the focus of future national agro-industrialization efforts, (2) Increasing government budgetary support towards the agro-industrial sector growth needs including, electricity grid expansion and land tenure security.

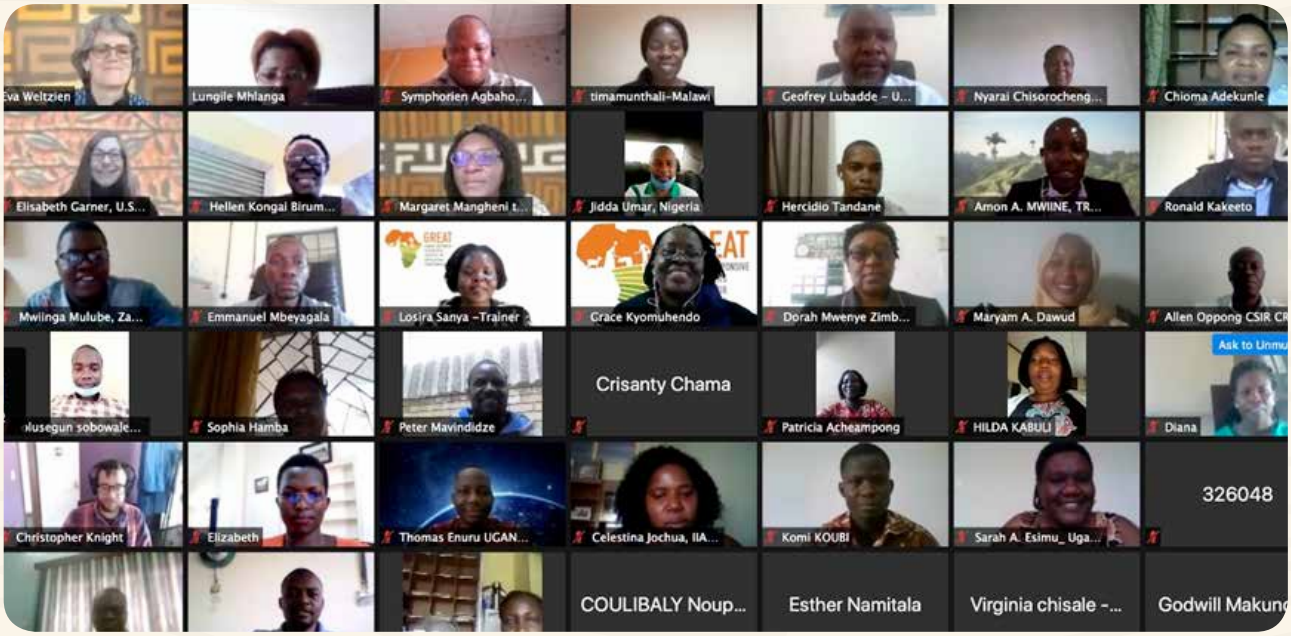
Bottom Left - Martin Fowler, the Senior Agricultural Adviser USAID Uganda
Bottom Right - Dr. Kisamba Mugerwa interacting with the Principal College of Agricultural and Environmental Sciences, Prof. Bernard Bashaasha (C)

The 4th Policy Seminar on Rural Development in Uganda

Makerere University College of Agricultural and Environmental Sciences (CAES) on 20th April 2021 held the fourth policy seminar on rural development. Rural Development, a process of improving the opportunities and well-being of rural people is of critical significance in Uganda where over 70 percent of the population still live in rural areas. Beyond agriculture, which is the mainstay of rural people, rural development encompasses health, nutrition, education, the environment, energy and a host of other social services to the rural people. With support from the Government of Uganda through the Research and Innovation Fund (RIF), Makerere University, the CAES launched monthly policy seminar series to re-ignite the debate and bridge the existing knowledge gap between research and policy making around the issues of agriculture and rural development. This initiative is being spearheaded by Dr. Rosemary Emegu Isoto. Other members include Prof. Bernard Bashaasha and Prof. Hyuha Theodora from the School of Agricultural Sciences.

GREAT Theme 5 Virtual Course: Equipping Agricultural Researchers with knowledge on Gender Responsiveness

Following a two-week training session dubbed "GREAT Theme 5 course", more than 50 researchers from more than 10 Sub-Saharan African countries were equipped with gender responsive knowledge to enable them to integrate gender into their crop breeding programmes. The training, which took place from 8th-22nd March 2021 was organized by Makerere University's College of Agricultural and Environmental Sciences (CAES) in collaboration with Cornell University under the project titled Gender-responsive Researchers Equipped for Agricultural Transformation (GREAT). Researchers were introduced to gender concepts, the relevance of gender to agriculture and plant breeding programmes in sub-Saharan Africa, key concepts pertinent to market and gender-responsive plant breeding, gendered qualitative and quantitative data collection methods, as well as gender responsive qualitative and quantitative data analysis. They were also taught about important factors to consider when conducting interdisciplinary research and how to apply gender to ongoing plant breeding projects.



A section of participants and trainers during the Theme 5 course

Participants at the end of the training

Mak GREAT & IRRI Train 30 Scientists from Asia on Gender Responsive Plant Breeding

Makerere University's Gender-responsive Researchers Equipped for Agricultural Transformation (GREAT) project in collaboration with International Rice Research Institute (IRRI) trained 30 plant breeders and social scientists from South Asia and South-East Asia on gender responsive rice breeding. The two weeks training was conducted via zoom from 17th-20th & 24th-27 May 2021. The purpose was to enhance the capacity of partners to develop gender responsive rice breeding strategies and products and understanding of gender responsive preference analysis to ensure the products address needs of men, women and the youth.

EfD-Mak Centre Policy Dialogue on changes in Lake Victoria

Makerere University Centre for Environment Development Initiative (EfD-Mak Centre) in December 2020 held a Policy Dialogue to deliberate on the changes in Lake Victoria's hydrology, water quality and livelihoods. Delivering a presentation titled **"Changes in Lake Victoria's Hydrology, Water Quality and Livelihoods"** the Director EfD-Mak Centre, Prof. Edward Bbaale emphasized the importance of the Lake Victoria Basin (LVB) as a critical transboundary natural resource, calling for urgent interventions to reverse the ecosystem damage. In a bid to protect the resource, participants called for the restoration and promotion of sustainable use of terrestrial ecosystems such as forests and wetlands in line with the UN SDGs. The dialogue was attended by officials from Makerere University, Wakiso District Local Government, and the Ministry of Agriculture, Animal Industry and Fisheries. It was also attended by representatives from the Police Environment Protection Unit.

Some of the participants pose for a photo during the workshop

NIL project First Contributing Authors' Workshop

In February 2021, Feed the Future Innovation Laboratory for Nutrition (NIL) project held the First Contributing Authors' Workshop to self-assess the papers at hand, criticise and improve them for publication. The aim was to produce a book in a simplified and non-technical language for policy makers. The meeting brought together contributing authors of over 10 chapters. The objectives of the meeting were; 1) appreciation of the activities of USAID Feed the Future Innovation Lab in Uganda; 2) improved and common understanding of individual Book chapters; and 3) agreed roadmap for Book completion (finalise writing, review, editors and publishers). Makerere University has been running the NIL project that is supported by USAID managed by TUFTS University and other partners since 2010.

According to the Principal Investigator, Prof. Bernard Bashaasha, the project has had two major data collections. The panel data that was done in 2012, 2014 and 2016 and then the Birth Cohort that was also done in 2016 covering about 5000 pregnant women. The project has generated over 30 academic papers that have been published.

Launch of the SDSN Uganda Network at Mak

The Sustainable Development Solutions Uganda Network (SDSN Uganda Network) was launched at Makerere University College of Agricultural and Environmental Sciences (CAES). The Network was launched virtually on 21st April, 2021 under the theme, "Unlocking the potential of Universities and other non-state actors to foster achievement of SDGs". The network is hosted by the Makerere University Centre for Climate Change Research and Innovations (MUCCRI) coordinated by Dr. Revocatus Twinomuhangi from the Department of Geography, Geo informatics and Climatic Sciences. The workshop held online was attended by over 60 participants comprising state and non-state actors (representatives of government sectors, members of the academia, the private sector, civil society organizations and international development partners). The e-conference was graced by the President UN SDSN Prof. Jeffrey Sachs who delivered the keynote address, the Vice President SDSN Maria Cortes Puch, the Senior Technical Advisor SDGs Secretariat Office of the Prime Minister –Uganda, Dr. Albert Byamugisha, and the Country Director Cities Alliance Uganda Samuel Mabala.

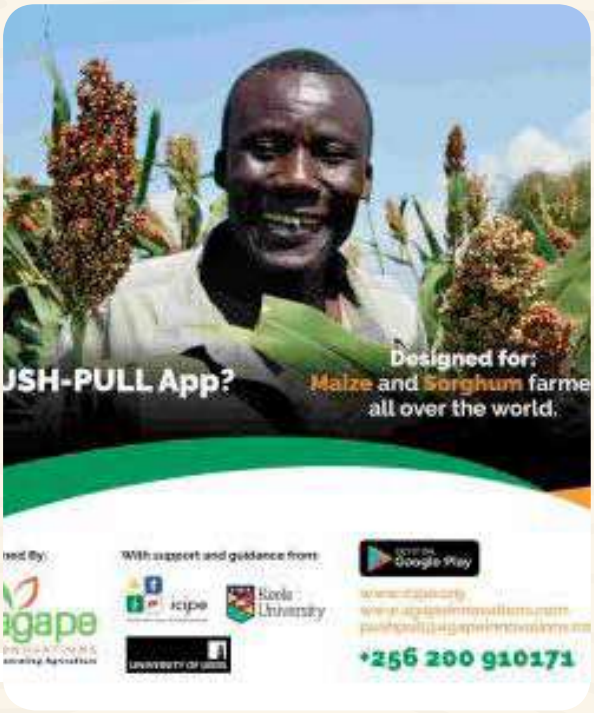
Dr. Revocatus Twinomuhangi (4th) flanked by the technical team during the online conference

INNOVATIONS

i) Mak student designs, "the Push-Pull App" to guide farmers control maize and sorghum pests

Makerere University student Paul Mugisha in collaboration with a team of scientists from ICIPE, Keele University and Leeds University developed a mobile app to help maize and sorghum farmers to control pests without using pesticides. Paul Mugisha is undertaking a Master of Science in Plant Breeding and Seed Systems at Makerere University's Department of Agricultural Production, School of Agricultural Sciences under the College of Agricultural and Environmental Sciences (CAES). Mugisha is also the Chief Executive Officer (CEO) Agape Innovations Ltd. The purpose of this app is to enable a farmer to do push-pull on his garden without interacting with an extension agent but purely using his mobile phone which does not only solve the problem of scarcity of extension workers, but also, prevents the spread of COVID-19.

The new app code-named, "the Push-Pull App", was launched and made available for use on google play store on 9th August, 2021 by an international team of scientists to support farmers across Africa to use innovative, environmentally-friendly techniques for evading crop pests. In a press release issued during the launch, scientists noted that African smallholder farmers face major challenges from insect pests such as fall armyworm, and weeds such as striga that can destroy their crops. Fall armyworm is a serious threat to food security and livelihoods and already affects at least 400,000 hectares, causing crop losses worth an estimated $3 billion a year. In the release, the "Push-Pull technology" was described as a novel method of crop management and a solution which can massively reduce farmers' losses from pests and increase their harvest sizes, whilst avoiding the need to use harmful and expensive chemical pesticides.



Left: Mr Pau Mugisha, the App designer

ii) Enhancing Value addition on Potato-Sorghum enterprises

Potato (Solanumtuberlosum) and sorghum (Sorghum bicolar) are potential pathways for enhancing household incomes, food and nutrition security in South-western Uganda which is characterized by land scarcity, decreasing agricultural productivity, high post-harvest losses and low per-capita income. Potato and sorghum are the region's main enterprises but their economic and nutrition potential are not fully exploited. Sorghum productivity and profitability are very low and potato harvest losses in form of non-marketable tubers are high. The project sought to enhance the value of both crops by innovative value addition that makes them complements. It also sought to reduce harvest losses, increase incomes, and make available to consumers a diversity of high quality products. The overall objective was to improve the economic value of potato and sorghum enterprises for improved livelihoods of the value chain actors.

The former Dean, School of Agricultural Sciences, also Principal Investigator, Prof. Johny Mugisha disseminating outcomes of his research project

iii) Unveiling a hybrid solar dryer for perishable agricultural products

Makerere University researchers in collaboration with pineapple farmers in Kangulumira Sub county and a team of experts from Green and Gold Uganda Ltd, Badaye Technologies Ltd and the Ministry of Energy and Mineral Development designed, constructed and promoted a Hybrid (sensor -controlled dual heat source solar) dryer to ensure consistent drying of large volumes of perishable agricultural produce. The hybrid solar dryer has a loading capacity of 300 kg of fresh and sliced fruits (approximately 450 pineapples each weighing 1 kg on average) per drying batch. A drying rate of 20kg/h and drying time of 10hr of continuous drying was recorded during dryer testing. Hence the dryer produces 20 kg of quality dried pineapple product per batch within a day. This technology was unveiled by Makerere researchers to the different stakeholders at Kisega Horticulture Association based in Kangulumira Sub-County in Kayunga district on 3rd March 2021. The Research work leading to the development of the HSD prototype was part of the Mak-RIF COVID-19 Special project titled, **"Developing an automatically controlled solar dryer and efficient resource recovery innovations for sustained market responsive fruit production in Uganda".** The estimated cost of the prototype hybrid solar dryer is UGX25,000,000 approximately $ 6,870 USD. The research and technology development was headed by Assoc. Prof. Ahamada Zziwa. Other members of the team were Dr. Isa Kabenge, Ms. Filda Aya, and Mr. Sam Cherotich from the Department of Agricultural and Bio Systems Engineering; Dr. Simon Savio Kzito from the Department of Forestry, Biodiversity and Tourism; and Mr. Amos Kambagambira Tamusuza from the Renewable Energy Department of the Ministry of Energy and Mineral Development.

Dr. Ahamada Zziwa and the consultant Sudo Paul at the facility

iv) Mak Unveils Recipes & Products for People Living with HIV/AIDS

Human Immunodeficiency Virus (HIV) is a global pandemic that is currently affecting 3.7 million people worldwide of which 70% are found in sub-Saharan Africa. Uganda continues to suffer from the scourge of HIV with the current prevalence of 7%. Healthcare of people living with HIV/AIDS in Uganda is constrained by poor nutrition with estimates of 25% suffering from malnutrition. A team of researchers led by Dr. Agnes Nabubuya from the Department of Food Technology and Human Nutrition in October 2020 embarked on the study titled, "Development of Nutrient-dense Recipes and Products from Underutilized crops to alleviate Malnutrition among HIV/AIDS Infected persons in Western Uganda (DoNDRP)". The study was fully funded by the Makerere University Research and Innovations Fund (Mak-RIF). Other members on the research team are Paddy Ainebyona, Dr. Robert Mugabi, Dr. Ivan Muzira Mukisa from the Department of Food Technology and Human Nutrition and Dr. Immaculate Nakalembe from the College of Veterinary Medicine, Animal Resources and Biosecurity (CoVAB).On 9th October, 2021 the research team unveiled four formulations of the neglected crops namely: Raw soup products, Instant soups, Raw porridge products and Instant porridge at Kigorobya sub-County. The Raw and Instant Nutrient-Dense porridge and soups were developed from neglected crops such as yam and yam leaves, climbing nuts, millet and cowpeas among others.The nutritional composition for an optimal porridge is Proteins (20.4%), Crude fibre (13.26%) Carbohydrates (42.21%), Iron (26.78mg/l), Zinc (42.75 mg/l0 while the nutritional composition for an optimal soup is Proteins (25.69%), Crude fibre (20.53%), Carbohydrates (36.27%) Iron (23.14 mg/l) and Zinc (38.92mg/l).

The PI-Dr. Agnes Nabubuya speaks about one of the products (Instant Soup Flour) during the workshop

The DoNDRP Project's product lineup- Soup Flour, Instant Soup Flour, Instant Porridge Flour and Porridge Flour

Undergraduate student Mr. Mwaka (white coat) serves some of the prepared soup to participants that gathered in the Kigorobya Sub County Community Hall, Hoima district

v) Project Launch

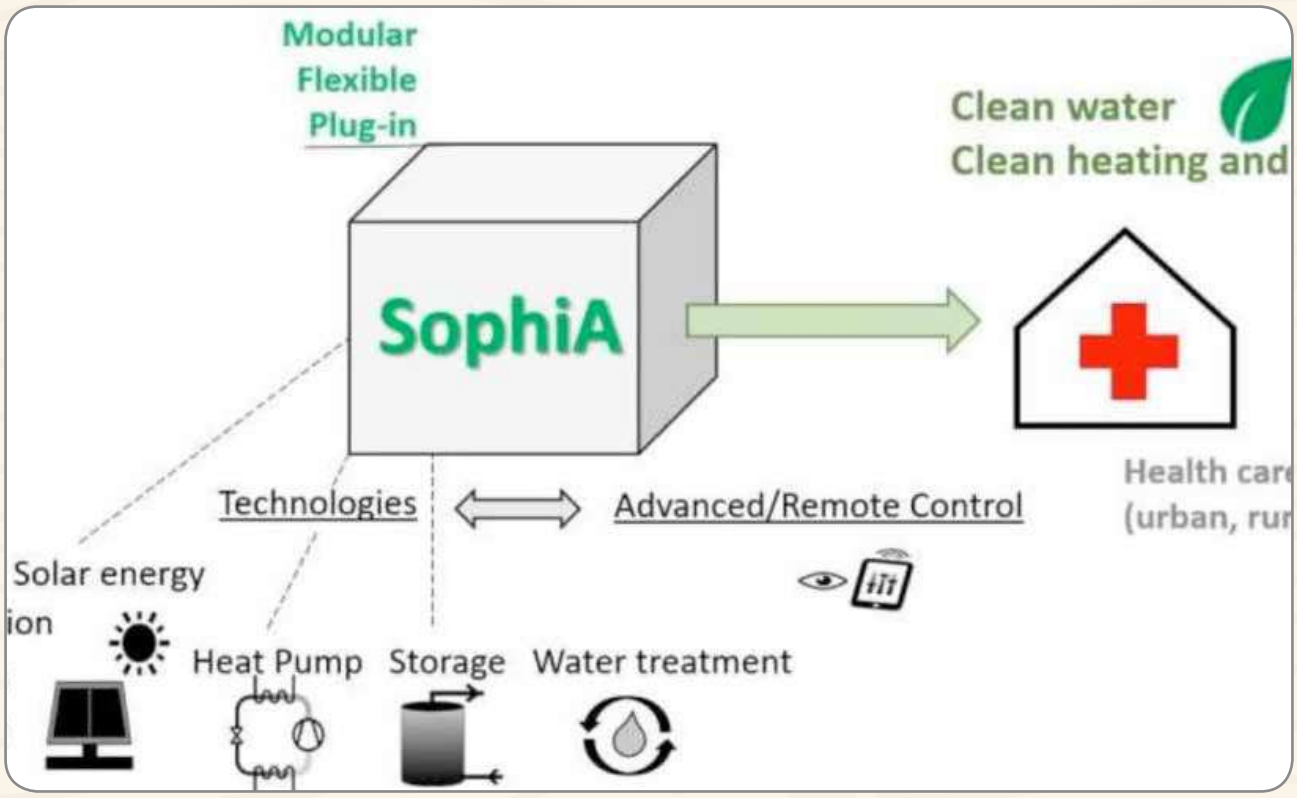
Sustainable Off-Grid Solutions for Pharmacies and Hospitals in Africa

Makerere University on 8th December 2021 officially unveiled an African project to Benefit Health Facilities across the continent. The Project is called sustainable Off-grid solutions for Pharmacies and Hospitals in Africa (SophiA). The launch was presided over by the Vice Chancellor of Makerere University Professor Barnabas Nawangwe.

The SophiA project will benefit both Makerere and the Health system in remote parts of the country by granting access to off-grid carbon-neutral electricity, heating and cooling of food and medicines, storage of vaccines up to -70°C as well as access to safe and clean drinking water. Makerere is partnering with 13 organizations across Europe and Africa in the project funded by the European Union

to ensure extended support to Health Centre Fours (HC IVs) across four African countries. It will be a 4-year multi-disciplinary project with activities in Burkina Faso, Cameroon, Malawi, and Uganda. Makerere University will take the lead in two of the project's nine work packages.

Work Package 1 (WP 1) is aimed at assessing the needs of several health facilities in the above mentioned countries in order to identify and match in each country ONE most significant and suitable health facility. The facility, which must be located in a rural remote region of the country will then be served by a SophiA system on a pilot basis. Makerere will also take the lead in work package 7 (WP 7), which will investigate the environmental, economic, and social aspects to demonstrate the benefits of SophiA solutions. During the launch, Vice Chancellor congratulated the team upon winning the grant adding that it is projects of this nature that will help Makerere implement its new strategic plan.



Prof. Barnabas Nawangwe (3rd R) with R-L: Prof. Bernard Bashaasha, Prof. Buyinza Mukadasi, Dr. Nicholas Kiggundu, Dr. Denis Muhangi, Dr. Sarah Bimbona and Mr. John Tumuhimbise- Ministry of Energy and Mineral Development at the SophiA launch (Photo by Alex Mugalu)

vi) Makerere & Partners to Develop Soybean Value Chain in Uganda

Makerere University College of Agricultural and Environmental Sciences (MakCAES) is working with partners to develop the soybean value chain in Uganda. This was revealed at the Soybean Mission hosted by the Centre for Soybean Improvement and Development (MAKCSID) on the 24th October, 2021 at the Makerere University Agricultural Research Institute, Kabanyolo (MUARIK). The partners involved in the initiative include Ministry of Agriculture Animal Industry and Fisheries (MAAIF), United Nations Development Programme (UNDP), United Nations Food and Agricultural Organization (FAO) and the Government of Russia. The potential of the crop has not been fully utilized in Uganda hence the initiative at hand. Soybean has been described as a miracle crop with many uses – people can eat them, drink them in milk alternatives, and take them in the form of supplements. Manufacturers may also extract the oil from soybean. The crop contains approximately 40% protein and 20% oil, both of which are vital in human and animal diet. With the available technology for processing soybeans at industrial and household level, soybean has become one of the most promising food crops available to improve the diets of millions of people in the world. Soybean contains at least 100% more proteins with yields of 5-10 times more protein per unit area than any other crop. The protein in soybean is also balanced with all the essential amino acids which the body cannot manufacture. According to Prof. Phinehas Tukamuhabwa, the Principal Investigator for the Soybean Breeding and Seed Systems at MakCAES, Makerere University is leading in soybean research in Uganda and the African region. Soybean varieties bred and developed by Makerere University are; Maksoy 1N, Maksoy 2N, Maksoy 3N, Maksoy 4N, Maksoy 5N and Maksoy 6N. These soybean support soybean industry in Uganda, where 94% of the Ugandan farmers grow Makerere University varieties.

The Principal MakCAES-Prof. Bernard Bashaasha (Black Coat), Prof. Phinehas Tukamuhabwa (Rear blue shirt) during the Soybean Mission hosted by MAKCSID at MUARIK on 24th October 2021

Some of the soybean varieties from Uganda and Zimbabwe at MAKCSID

The PI, Prof. Phinehas Tukamuhabwa (L) showcasing some of the soybean varieties at MAKCSID

A field of soybean varieties under trial at MAKCSID, MUARIK, Wakiso, Uganda

vii) CONSORMIP Project

The BIOINNOVATE funded CONSORMIP project in full "Commercialization of novel sorghum and millet products for improved socio-economic gains in Eastern Africa" is set to end on a high note. The project was a partnership between Makerere University, Sokoine University of Agriculture in Tanzania and Hawassa University in Ethiopia. The project targeted to address the market gap - lack of value added convenient and nutritious sorghum and millet based products particularly instant porridge flour, puffed snacks, and complimentary porridge flour. To this end, this project commercialized the named products made from sorghum and/or millet. A lean business start-up and business incubation approaches to commercialize the product. This approach is expected to deliver tangible benefits to the target beneficiaries namely small holder farmers, malnourished children and mothers as well as school going children. CONSORMIP Project to Close on A High Note In Spite of COVID -19 Disruptions The project developed and supported SMEs in each partner country as a vehicle for commercialization of the developed value added products in the respective countries. The products and spinoff SMEs are set to be launched soon at the end of project meeting to be held at Soikine University of Agriculture in Tanzania. This project was funded by the BIOINNOVATE AFRICA program and run 2018-2020 with Assoc. Professor Yusuf Byaruhanga as PI.

viii) NUTRIFOODS

NUTRIFOODS project "Innovative approaches to value-addition and commercialization of climate-smart crops (CSFC) for enhanced food security and nutrition in Africa and beyond" is a cooperation between African and European Universities and private sector. The aim of NUTRIFOODS is to enhance food and nutrition security and improved livelihoods of stakeholders in the climate-smart food crops (CSFC) value chain. This to be achieved through developing and testing improved baking ingredients from climate-smart crops in Africa; commercializing the new ingredients; and improving capacity for training, research and development in CSFCs namely cassava and cowpeas.

The project has completed a consumer survey in which users and consumers of the developed ingredients and their needs were established; screened different cassava varieties in Uganda for processing suitability different industrial applications; developed processing protocol for cassava and cowpeas to impart properties for different industrial applications. The project is also supporting graduate students. The NUTRIFOODS project is supported by the Government of Uganda and European Union under the LEAP AGRI program. The project partners are Wageningen University – Netherlands, Bake Five BV – Netherlands, Technical Research Center of Finland – Finland, University of Pretoria – South Africa, University of Venda – South University, Bakery Incubation Center (BICSA) – South Africa, Kenya Industrial Research and Development Institute – Kenya, Nutreal Ltd – Uganda and Makerere University, with Dr Yusuf Byaruhanga as the PI.

ix) InnoFoodAfrica Project Implementation Takes Root

The InnoFoodAfrica project in full "Locally driven co-development of plant based value chains towards more sustainable African food systems with healthier diets and export potential" is exploring climate-smart African crops (cereal-pulse-root crop-fruit) in Ethiopia, Kenya, South Africa and Uganda. In Uganda the project is focusing on banana, millet, cowpeas, and amaranth. The project is developing develop and will demonstrate optimal solutions for cultivation practices, processing and productization towards new value chains, thus enhancing nutritionally balanced food consumption in Uganda and creating opportunities to reach international markets. The main output is to demonstrate the huge potential of the African crops as healthy ingredients in combating both under and over nutrition. The emphasis is to target vulnerable groups, such as malnourished children, pregnant women and adults under the risk of obesity, by increasing the diversity of affordable, nutrient-dense and healthy food products based on local crops, and educating people for improved eating habits. The project addresses key bottlenecks of African food value chains - low productivity, limited access to urban markets, affordability and convenience of end products - by tailoring actions on local context to develop novel technologies in agriculture, food processing and use of residual biomass for packaging, and concurrently to investigate food safety, food security and food loss reduction.

Trainings, targeting farming and business communities covering farming productivity of indigenous crops, effective post-harvest technologies, valorization of biomass residue materials, nutritional guiding, and entrepreneurial skills. The project will also foster international cooperation with other EU-Africa and inter-African projects (FNSSA).

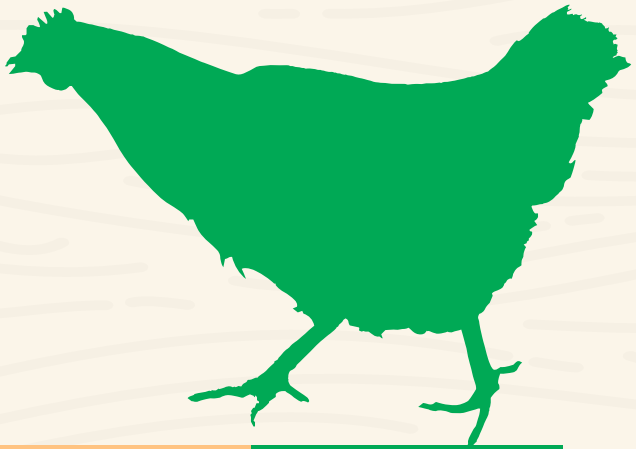
x) InnoFoodAfrica Project

This far, the project has implemented several farmer participatory research activities in eastern and central Uganda; developed ingredients with improved functional properties from banana, millet cowpeas and amaranth for use in different food applications; surveyed the agricultural side streams and characterized them and is currently completing a food consumption survey in the project research areas. The project is supporting several graduate students and is working with the private sector to ensure technology uptake and commercialization. The project partners in Uganda include Makerere University, Kulika Uganda, FONUS Ltd, Uganda Manufacturers Association. At Makerere University the project team is composed of Dr. Geoffrey Tusiime, Dr. Stellah Byakika among others and led by Assoc. Prof. Yusuf Byaruhanga. InnoFoodAfrica project is funded by the European Union under the Horizon 2020 Program and will be running 2020 to 2023.

OUTREACH PROGRAMMES

Launch of the Native Chickens Programme and Incubator

In 2021, Makerere University College of Agricultural and Environment Sciences (CAES) launched an incubator with the capacity of 1000 eggs at the University Agricultural Research Institute Kabanyolo (MUARIK) for training, research and farmers' capacity building. The UGX4.5 million incubator was locally made in Uganda by Butenga Farmers, a company based in Kiira but, if imported, it costs UGX10million. The incubator is to serve the university for teaching courses on poultry production, hatchery management and for people who want to do experiments. The incubator was procured under the Native Chickens Project funded by the African Union (2019-2021). It is a collaboration between institutions from two countries -Mozambique and Uganda with the project lead at Eduardo Mondlane University Mozambique. At Makerere University, the project is spearheaded by Dr. Donald Rugira Kugonza from the Department of Agricultural Production. The project broad objectives are to increase the number of eggs and the amount of meat produced by the local chickens and to evaluate the effective models or processes to disseminating improved chicken technologies in Uganda and Mozambique.



Centre: Dr. Okello Cyrus Ongom (R) checking what is in the incubator after the launch
Below: The Director Dr. Okello Cyrus Ongom led to tour the free range system of local chickens at MUARIK

ii) More Pork Project: Training Mpigi and Wakiso pig farmers on Artificial Insemination

Researchers from the College of Agricultural and Environmental Sciences (CAES), Makerere University in collaboration with Veterinary Officers from Vetline Services, Mukono District trained farmers in Mpigi and Wakiso districts on pig productivity and African Swine fever management. Under their project titled **"Improving pig productivity and income through an environmentally sustainable and gender inclusive integrated intervention package",** the researchers led by Dr Donald Kugonza equipped over 300 pig farmers in Buwama, Nkozi, Kyengera, Wakiso, Kakiri, Mende and Kasangati Town Council with skills on Artificial Insemination. The farmers have also been trained on the identification and management of diseases in pigs, vaccination, identification of the best breeds, feeding of pigs, and biosecurity. The activity intended to boost pig herd genetics, productivity and marketability of the products is a component of the More Pork Project supported by the International Livestock Research Institute (ILRI). Through the More Pork Project, ILRI works with partners worldwide to enhance the roles that livestock play in food security and poverty alleviation, principally in Africa and Asia. The project is coordinated by Dr Karen Marshall, Principal Scientist at ILRI. It is implemented in four districts in Uganda namely; Mukono, Mpigi, Wakiso and Masaka. During the five-day activities that started on 22nd November 2021 in Buwama, Mpigi District and ended in Kasangati Town Council, Wakiso District on 26th November 2021, the trainers including Mr Robert Natumanya from CAES, Makerere University, Dr Leonard Kawule from Vetline Services, Mukono and Nalongo Nankya Ruth from the same company extensively trained the farmers on the process of Artificial Insemination, highlighting the benefits and cautioning them on the mistakes. The farmers were specifically trained on the critical success factors of Artificial Insemination. These include proper heat detection by the farmer, supply of quality semen doses, optimal timing of insemination, good farm management practices and herd fertility.

Left: Dr Donald Kugonza training farmers in Kyengera Town Council
Right: Dr. Leonard Kawule training Kasangati Town Council pig farmers on artificial insemination

Some of the farmers who were trained

iii) More Pork Project: Supporting farmers to determine weight of pigs for more appropriate pricing

ILRI funded another component under More Pork Project on Determining Pig Weights. Over 13 pigs in each of the 162 farms of pigs in five (5) districts, including: Hoima, Masaka, Mpigi, Wakiso and Kamuli, were weighed. The exercise was aimed at assessing the pig weights in five (5) districts mentioned above. The results provided enhanced scientific-based weighing methods as an alternative substitute for eye-based estimates which led to cheating of farmers by buyers despite the high costs of pig feeds. In his remarks, Dr Donald Kugonza commended the Deputy District Veterinary Officer, Masaka Mr. Sserwanyira Henry for the quality of pigs that presented the best weights the district. In a pre-assessment meeting, Mr. Sserwanyira informed the team of an outbreak of African Swine Fever in Masaka, noting that 3 cases had been identified at City Abattoirs. Besides African Swine Fever, Mr Sserwanyira said Masaka Pig Farmers were experiencing challenges of inadequate market and high prices of feeds.

iv) Researchers Meet to Enhance Collaborations Between Animal Scientists in Breeding and Genetics

The College of Agricultural and Environmental Sciences (CAES) hosted a virtual meeting of the Uganda Animal Geneticists on 17th December 2021. The meeting was aimed at figuring out collaborations in and outside Uganda in areas of animal breeding and genetics. In his remarks, Mr. Agaba Morris emphasized the need for more collaborations amongst African countries, saying the latter tend to collaborate more with European countries. Dr Donald Kugonza, an Assoc. Prof at CAES presented the research activities on genetics and breeding currently being undertaken at the college especially on: chicken, fish, goats and cattle. "Our main focus in chicken breeding is: improving the quality and quantity of chicken, increasing egg production and weight," he said. In his remarks, Mr. Mukiibi Robert, a Research Fellow at Rosline Institute of Edinburgh, stressed the need to have a human genetics specialist on the ASUPA team. "Human genetics is lacking so much, there is need to diversify genetic research". Mr. Mukiibi called for enhanced sensitization of the government on the importance of genetics and genomics. He also called on the College to put in place measures to attract graduate students to animal genetics and genomics courses.

v) Training Livestock farmers on Climate-Smart Supplementary Feeding Technologies

Livestock farmers from the 10 districts within Disease Control zones 1 and 2 of the cattle corridor of Isingiro, Masindi, Kiruhura, Lyantonde, Mubende, Kibaale, Nakaseke, Kyakyanzi, Masindi, Kiryadongo and Nakasongola underwent a two weeks intensive hands on training on the production of climate smart supplementary feeding to increase beef production in Uganda. The training was organized under the Promote Supplementary Feeding (SUPPL-F) project in collaboration with Robran Holdings Limited (RHL), the Private Sector Foundation Uganda (PSFU), Makerere University College of Agricultural and Environmental Sciences(CAES), The Green Elephant (TGE), the Livestock Development Programme (LDF) and Orchid House Farm Nakasongola. Promote Supplementary Feeding project is part of a European Union (EU) grant (under the 11th European Development Fund) extended to the Government of Uganda to a programme known as "Developing a Market-Oriented and Environmentally Sustainable Beef Meet Industry in Uganda (MOBIP)" implemented by the Directorate of Animal Resources (DAR) under the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). The programme awarded Private Sector Foundation Uganda (PSFU) and her six partners to implement a EUR 715,299 focusing on farmers' access to and utilization of supplementary feeds for purposes of fattening animals for the Market. The trainees included farm managers of large-scale beef farmers (referred to as Nucleus farmers which are to be demonstration farms) linked to the implementation of the PSFU MOBID project. The participants also included Trainers of Trainers (TOTS) mainly small scale beef producers and women and youth entrepreneurs recruited by the project and currently engaged in similar or related activities in the participating districts. The intention of this training was to ensure the TOTs and Farm managers are well equipped to act as ambassadors to pass on the knowledge and skills to small – holder farmers for use in their respective districts thus promoting supplementary feeding.

vi) Promoting feedlot technology to boost livestock production in the Cattle corridor

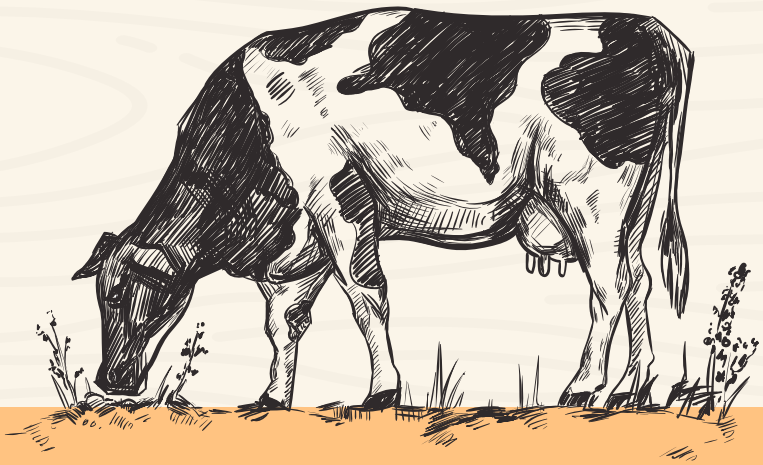
Private Sector Foundation Uganda is working with four other partners including Makerere University College of Agricultural and Environmental Sciences to implement a project to enhance livestock production. The project is funded by the European Union and is currently under the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). The project referred to as Promote Supplementary Feeding is focusing on farmers' access to and utilization of supplementary feeds for purposes of fattening animals for the Market. Promote supplementary Feeding (Suppl-F) project is part of a European Union (EU) grant (under the 11th European Development Fund) extended to the Government of Uganda to a programme known as "Developing a Market-Oriented and Environmentally Sustainable Beef Meet Industry in Uganda (MOBIP)". The implementation of MOBIP lies with Directorate of Animal Resources (DAR) under the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF).

The Suppl-F project expects to contribute to the achievement of MOBIP's result area two (R2) and sub-result area 2.6 'supplementary feeding promoted'. The 28 months project that run from 12th August 2019-December 2021 in the Central and South-western parts of the cattle corridor, in two areas formerly defined by MAAIF as Disease Control Zones (DCZ 1 & 2) and in Kampala and Wakiso for operations, is aimed at in increasing access and uptake of supplementary feeding in the districts of Kiryandongo, Kyankwanzi, Masindi, Nakaseke & Nakasongola, Lyantonde, Mubende, Kibaale, Kiruhura and Isingiro. The Private Sector Project Manager for Promote Supplementary feeding project, Mr. Daniel Ojiambo noted that about 85% of total meat marketed in Uganda comes from indigenous livestock, which thrive on natural pastures in the rangelands.

Animals feeding in a feedlot

vii) Promoting use of Urea Molasses Blocks as supplements for beef production in Central and Western cattle corridors

About 40 livestock farm managers and farmers from 10 districts in the Central and Western cattle corridor were trained in the production of Urea Molasses Blocks/Multi-nutrient blocks as supplementary feed to boost beef production in the country. Molasses urea blocks (MUB) are high protein-energy concentrated feeds containing the necessary amounts of minerals and vitamins and supply Non-Protein Nitrogen (NPN) to the rumen microbes. Low quality pastures and crop residues are deficient in fermentable nitrogen, carbohydrates and minerals. The blocks are therefore a strategic feed supplement for ruminants as they provide a constant source of fermentable nitrogen and energy throughout the day to promote growth of the rumen microbes and the animals. The training was conducted at Makerere University Agricultural Research Institute Kabanyolo organized under the Promote Supplementary Feeding (SUPPL-F) project. The project is implemented by the Private Sector Foundation Uganda(PSFU) and partners at a total budget of EUR 715,299 for a period of 28 months from the 12th August 2019 to December 2021. The collaborating partners include Robran Holdings Limited (RHL), Makerere University College of Agricultural and Environmental Sciences(CAES), The Green Elephant (TGE), the Livestock Development Forum (LDF) and the Orchid House Farm Nakasongola. Makerere University lead instructor is Dr. Justine Nambi.



Top: Dr. Justine Nambi teaching farmers how to make the blocks at MUARIK
Below: Trainees molding the blocks

viii) Livestock Farmers Skilled on Pasture Production and Management

About 40 livestock farmers from 10 cattle corridor districts in Central and Western Uganda were re-tooled on pasture production and management to enhance their capacity to improve animal nutrition, farm yields and profits. Pastures are the cheapest source of feed for livestock and are mostly made up of grasses and legumes with high levels of required nutrients that are needed by animals for quick maturity, increased production, good health and quality products. The farmers attended lessons at Makerere University Agricultural Research Institute Kabanyolo (MUARIK) and conducted practical sessions at Robran Holdings Limited (RHL), in Buwanuka- Wakiso district. The trained farmers were expected to go out and train fellow farmers in their respective districts on how produce and manage pasture for supplementary feeding. The training was organized under the Promote Supplementary Feeding (SUPPL-F) project. The SUPPL-F project is part of the Developing a Market -Oriented and Environmentally Sustainable Beef Meat Industry in Uganda (MOBIP) which is a Government of Uganda programme supported by the European Union (EU) under the overall supervision of the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). The project was implemented by the Private Sector Foundation Uganda (PSFU) and partners at a total budget of EUR 715,299 for a period of 28 months from the 12th August 2019 to December 2021. The project Principal Investigator at Makerere University is Dr Denis Mpairwe.

Above: CEO Robrans Holding Brian Natwijuka (in green tshirt) training farmers on the different pastures
Below: Farmers studying pasture weed management at Robrans Holding at Buwanuka in Wakiso district

ix) Farmers and Agricultural Extension Officers advised on provisional fertilizer rates in low land rice production areas

Namutumba is found in the eastern region, about 170 Km from the capital city Kampala.

The district terrain is made up of numerous wetland soils (Gleysols – wet soils with good SOC retention and redoximorphic features) that makes lowland rice a major crop enterprise. However, the marketable rice volumes are low because of poor land productivity. In most rice fields, the average yield is 1.7 tons/ha which is far below the potential yield of 6 tons/ha. Though some farmers use fertilizers, the overall application rates among lowland rice producers is still low.

In order to contribute to improved agricultural productivity, the government of Uganda through the Makerere University Research Innovation Fund (MAK-RIF) supported researchers to undertake a project titled **"Upgrading interim fertilizer recommendations in priority crops for improved agricultural productivity in Uganda".** The project focused on rapid soil testing and plant tissue analysis of different crops (maize, upland rice, lowland rice and banana) with the aim to develop interim (provisional) fertilizer rates for improved crop productivity. It is led by Dr Patrick Musinguzi as the Principal Investigator (PI) and co-PIs include Prof. Jackline Bonabana, Dr. Crammer K. Kaizzi, Dr. Emmanuel Opolot and Dr Peter Ebanyat. Seventeen (17) lowland rice fields across the district were selected for the study.

In each field, one composite soil and plant sample was collected, and analyzed in the Soil and Plant Analytical Laboratory in order to determine current nutrient contents and concentrations. The findings are that Gleysols in Namutumba district contain some iron, manganese, moderate levels of SOC, Nitrogen but notably deficient in Phosphorus, Potassium and Zinc. On the other hand, rice plant samples contained low amounts of nitrogen, phosphorus and Potassium thus a need for measures to improve nutrient uptake. The impact of findings was shared with the stakeholders in a dissemination meeting on the 12th August, 2021 at Nsinze Sub County Council Hall.

According to the available data, Dr Musinguzi advised farmers to apply provisional fertilizer rates to supply Nitrogen, Phosphorus and Potassium and Zn. The provisional rates for lowland rice were reported to be in the range of 139-205 Kg/ha Urea (eq. 64-94 kg N/ha); 60-175 kg/ha DAP (eq.12-34 kg P/ha) and 180-542 kg/ha MOP (eq. 90-271 kg K/ha). In addition, the needed rates for zinc fertilizers are 3-28 kg/ha Zinc Sulphate. He however cautioned that the high market prices of fertilizers might render it hard for farmers to use the proposed rates unless an appropriate policy action is put in place.

Dr. Patrick Musinguzi and Mr. Monday Paga, taking a close observation of the soil on one of the fields in Namutumba district.

x) Mak Researchers Advise Agriculture Extension Officers and Farmers on right fertilizer package for Banana

Uganda still ranks one of the leading producers of banana with the East African highland bananas (AAA-EAHB), locally known as Matooke contributing the bulk (Approx. 80%) of total banana production. Matooke is grown by several farmers and is a major source of food and income. Because of its importance and relevance to the country's economic development, researchers have gone ahead to develop high value products such as matooke flour, banana chips, banana extruded high energy foods and many other products.

However, in order to achieve sustainable banana production, there is need to continuously establish measures on how soil fertility management can be improved. It is now increasingly apparent that on-farm productivity of bananas in the region has declined. Several farms report a low average annual yields ranging from 10 to 20 tons/ha/year, which are below the potential yields of about 60 tons/ha/year. The yield gap is attributed to declined soil fertility, climate change effects, pests and diseases. The low soil fertility is mainly associated to nutrient mining, leaching, soil erosion, and inherent poor chemical nature of most soils. Mulching, which is a traditional practice for soil water conservation and soil organic matter improvement in banana is very expensive for most farmers due to limited access to the materials.

The organic materials in the form of animal manure is equally not easily accessible. The use of mineral fertilizer is still very low in the banana cropping systems. As a result, soil fertility decline has now increasingly become a challenge and threat to sustainable banana productivity. Through the Government of Uganda-Makerere University Research and Innovation Fund (MAK-RIF), a project was funded to undertake research titled "Upgrading interim fertilizer recommendations in priority crops for improved agricultural productivity in Uganda". The project focused on rapid soil testing and plant tissue analysis of major crops in Uganda, that is, maize, upland rice, lowland rice and banana. For the Banana crop, the project embarked on the on soil and plant testing with the ultimate goal of developing interim (provisional) fertilizer rates for banana production. The team was led by Dr. Patrick Musinguzi as the Principal Investigator (PI) together with co-PIs who included Prof. Jackline Bonabana, Dr. Crammer K. Kaizzi, Dr. Emmanuel Opolot and Dr. Peter Ebanyat. Three districts were selected in the central region (L. Victoria Crescent) for the study. These included Wakiso, Buikwe and Mukono. A total of 26 banana fields with Mpologoma variety were randomly selected targeting two main soil types. A total of 15 fields were from Mukono and Buikwe (predominantly Luvisols) while 11 were from Wakiso districts (mainly on Ferralsols).

In the presentation of the results, the Principal Investigator, Dr. Patrick Musinguzi emphasized that soil organic carbon levels across most fields were very low and needed boosting by increasing application of organic materials. Cognizant of the high volumes needed and the difficulty in sourcing mulches, he urged farmers to explore ways of improving production and access to organic wastes.

Left: Soil sampling in one of the banana fields in Mukono district
Right: Dr. Patrick Musinguzi explains the findings to stakeholders at Nakisunga Sub County council hall

xi) Mak researchers guide upland rice and maize farmers on production, fertiliser application

Maize and upland rice are very important to Uganda's agricultural sector. The two crops are grown by many smallholder farmers in the country for both food security and income, especially in Bunyoro region. Over the last two decades, the total production of Maize and rice has gradually increased. For instance in 2014, the Food and Agriculture Organization (FAO) reported that the quantity of rice produced in Uganda increased by 26% from 1997 to 2007. Similarly, total maize production in the country increased from roughly 800,000 tons in 2000 to 2,575,000 tons in 2019. This trend in production is explained more by the steady expansion in acreage cultivated than from increased productivity per acre. Low productivity is an established and well documented challenge facing Uganda's agricultural sector. This is mainly because most soils on which the crops are grown have declined greatly in fertility but also due to low fertilizer usage, pests and diseases and other production constraints. There is also reported evidence of changing climate which further negatively affects maize and rice production.

To address the issue of low yields due to low soil fertility, the government of Uganda through Makerere University Research Innovations Fund (MAK – RIF) funded a project 'Upgrading interim fertilizer recommendations of priority crops for increased agricultural productivity in Uganda'. Dr Patrick Musinguzi was the Principal Investigator on the project. The project focused mainly on conducting a rapid soil testing and plant tissue analysis study of the two crops in Bunyoro region. To carry out the study, two main soil types in Bunyoro on which maize and upland rice are grown were identified. The soil types included the Ferralsol in Hoima district and a Regosol in Kikuube district. Ferralsol are soils that are generally very old soils (highly weathered) with low cation exchangeable capacity, high kaolinite and high Fe and Al oxides while Regosol are weakly developed mineral soils in unconsolidated materials. These are dominated by stones and the parent material still undergoing weathering.

The high stone content is also characteristic of high iron levels. 15 soil samples and plant samples were collected from each field of each crop, tested in the soil and plant laboratory at Makerere University for pH, SOC, texture, TN, avail. P, extractable K, Ca, Mg, and Fe, Mn, Zn. Computations were also made on potential profitability of both crops when fertilizers are used. Key informants provided information on current maize and rice production processes, and associated costs to support the computations used in the research. The findings from the study were shared with the stakeholders in a dissemination meeting that was held on the 27th August, 2021 at Buhimba Sub County Community Hall in Kikuube district. The audience comprised of upland rice farmers, maize farmers and extension staff of Kikuube and Hoima districts.

Soil sampling in upland rice fields in Buhimba S/C

Top: Soil sampling in maize fields in Mparo, Hoima City
Below: Presentation to stakeholders at the dissemination meeting on Kikuube district

xii) Mak Drylands Transform Project launched in Moroto District

Makerere University received the blessing and support of community and administrative leaders to implement the five-year Drylands Transform Project in Moroto district. This was during the project inception workshop held in the Planning Unit boardroom at the Moroto District Headquarters on 21st October 2021. The inception workshop was held to kick start the project. The meeting brought together over 20 participants comprising mainly the district technical, administrative staff, both political and those in the civil service. The meeting was also attended by representatives of different projects operating in Moroto including Welthungerhilfe project, GIZ and Karamoja Agro-pastoral Development Programme that mainly focus on Livelihoods, food security and hunger.

The Swedish University of Agricultural Sciences is leading a multidisciplinary team of researchers from Umea University, Gothenburg University, University of Nairobi, Makerere University, World Agroforestry (ICRAF) and the Intergovernmental Authority on Development (IGAD). The project: "Achieving the SDGs in East African drylands: Pathways and challenges towards a transformation of landscapes, livestock and livelihoods in the East African drylands (Drylands Transform)", will be implemented in the greater Karamoja cluster of Uganda and Kenya. It is funded by the Swedish Research Council for Sustainable Development. It is aimed at contributing new knowledge for transformative change and sustainable development of rangelands in the drylands of East Africa.

The Principal Investigator Drylands Transform Project, Dr Denis Mpairwe (Front 2nd L) with Moroto District Leadership and development partners after the Inception Workshop on 21st October 2021 at Moroto District Headquarters

The Principal Investigator, Dr Denis Mpairwe

xiii) Mak Granted 10 Hectares in Poron, Napak to set up Livestock Café & Tick Control Demos

Makerere University was handed 10 hectares of land in Poron Sub County, Napak District to set up a livestock café with a tick control demonstration site. The land was handed over from Poron Sub County to the Napak and Moroto District Technical and Political officials and then to the University on 23rd October 2021. The demonstration site and knowledge hub are to be implemented under the Drylands Transform Project funded by the Swedish Research Council for Sustainable Development, aimed at addressing complex challenges in the East African drylands such as climate change, food insecurity, land and ecosystem degradation and weak institutions. Drylands Transform investigates the inter-linkages between land health, livestock based livelihoods, human wellbeing and land governance mechanisms in order to contribute to transformative change and sustainable development of the social ecological system in drylands of East Africa. The 10 hectares were handed

over following a series of meetings between the Makerere University research team and Napak and Moroto District Local Governments and Poron Sub-County Technical and Political officials, wherein the research team sought permission and support to implement five-year project activities for the benefit of the agro- pastoralists and pure pastoralists. Makerere University's Principal Investigator is Dr Denis Mpairwe.

Napak and Moroto District officials (in blue and green t-shirts) hand over the site in Poron Sub County, Napak to the Drylands Transform Project Principal Investigator, Dr. Denis Mpairwe (L) on 23rd October 2021

xiv) Mak Secures another 10 Hectares in Rupa Sub-County Moroto for Livestock Café

Makerere University secured an additional 10 hectares of land from the pastoralist community in Rupa Sub County, Moroto District for the establishment of a livestock café. The allocated land comes with a valley tank and cattle crush. This was the Drylands Transform Project's second land offer in the Karamoja sub-region following the first in Poron Sub-County, Napak District. Livestock cafés will be the experimental sites to study forage productivity, establish novel co-learning and knowledge exchange centres and create opportunities for milk and fodder value chains. The land was handed over to the project by Moroto District and Rupa Sub-County Technical and Administrative officials and witnessed by clan leaders at Lokapel Village on 24th October, 2021. The valley tank and cattle crush within the project site were also handed over to the research team and supplemented by an alternative site in the event of insecurity during the December –January dry spell.

The Sub County and Village officials (R) symbolically hand over the site to the Moroto District team (L) on 24th October 2021, The Drylands Transform Project Principal Investigator, Dr Denis Mpairwe at the rear end of the cattle crush

xv) Mak recognized at the 5th Africa-wide Agricultural Extension Week(AAEW) for its contribution to research and training

Makerere University was recognized for its great contribution to agricultural research and training. This was during the 5th Africa-wide Agricultural Extension Week (AAEW) that took place on 14-20th November 2021 at Speke Resort Munyonyo in Kampala, Uganda. The event was co-hosted by the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), the African Forum for Agricultural Advisory Services (AFAAS) and the Uganda Forum for Agricultural Advisory Services (UFAAS). Organized under the theme "Effective Agricultural Extension Systems for Sustainable Agripreneurship in Africa" , the week-long blended physical and virtual event attracted over 1,000 participants from 17 countries in Africa. The event was officially graced by Uganda's Prime Minister, represented by the First Deputy Prime Minister, Alhajji Moses Ali; the Minister of Agriculture, Animal Industry and Fisheries (MAAIF), Hon. Frank Tumwebaze; the Permanent Secretary of MAAIF, Maj. Gen. David Kasura Kyomukama; the President of AGRA represented by Vice President, Program Innovation & Delivery, Ms Agnes Asiimwe

Konde, the President of Sasakawa Africa Association and the Commissioner of Agriculture at the African Union, among others. Key highlights that emerged include: the need to initiate and strengthen partnerships for greater impact, rebranding extension to attract the youth, and adopting gender-responsive approaches, tools and methodologies.

The latter was emphasized by Dr Harold Roy-Macauley, Regional Director, East and Southern Africa, One CGIAR, who fronted gender equality as one of the strategic directions. He also expressed a desire to link with AFAAS for scaling CGIAR innovations in Africa. Makerere University's College of Agricultural and Environmental Sciences (CAES) is a member of the Uganda Forum for Agricultural Advisory Services (UFAAS) and was integral in organizing the event. At the event, CAES was represented by Prof. Margaret Najjingo Mangheni, the Founding Chairperson of UFAAS and Board member of AFAAS; and Dr Richard Miiro, the Board member of UFAAS representing academic institutions in Uganda.

Prof. Margaret Najjingo Mangheni (L) receiving a package on behalf of Makerere University from Dr. Henry Nakelet (R)

Prof. Margaret Najjingo Mangheni (2nd row, left) and some of the dignitaries at the official opening of the AAEW 2021

xvi) Skilling roadside plant nursery owners on business management and sustainable practices

Uganda's roadside urban and peri-urban plant nurseries are a unique small-scale business that play a critical role in poverty eradication by acting as green businesses and providing employment to many youth and women. However, their growth and sustainability is threatened by inadequate requisite business management skills and knowledge. To remedy this, a multi-disciplinary team of researchers from the College of Agricultural and Environmental Sciences (CAES), College of Natural Sciences (CoNAS), and the College of Business Management (CoBAMS), Makerere University have embarked on activities to build business management skills and sustainable plant nursery management practices among their owners, operators, and workers. The researchers namely; Dr Edward Nector Mwavu (Principal Investigator), Dr Anthony Tibaingana, Dr Paul Ssegawa, Dr Grace Nakabonge and Ms. Agatha Syofna are working in collaboration with officials from the Ministry of Local Government and National Agricultural Research Organization (NARO). The activity is intended to enhance profitability of the roadside plant nursery business. Through their project titled "Building business management skills and sustainable practices among urban and peri-urban roadside plant nursery owners, operators and workers for resilient 'green' businesses in Greater Kampala, Uganda, the researchers are training roadside farmers on the best plant and business management practices. The project is supported by the Government of Uganda through the Makerere University Research and Innovations Fund (Mak-RIF).

Dr. Edward Mwavu training the roadside plant nursery owners and workers in Kawanda

xvii) Unlocking the Potential of Kasese Smallholder Farmers' Urban Food Systems Resilience for Food Security

AgriFoSe2030 Programme is a global initiative on agriculture and food security funded by the Swedish government. The programme has three (3) main thematic areas of consideration in the field of agriculture and food security: (1) Training and capacity building, (2) High quality synthesis and analysis and (3) Innovative platforms and Knowledge networks. The challenges aligning with the thematic areas AgriFoSe2030 addresses include: (1) Improving access to safe and nutritious food, (2) Agricultural productivity and ecosystem functions, (3) Science-based innovation and extension and (4) smallholder agriculture within transforming food systems. In response to these challenges, AgriFoSe2030 is implementing four projects in different countries: (1) Transformation of pastoral livelihoods in Kenya, addressing challenge 1 and 4, (2) Smallholder and the e-commerce of fruits in Vietnam, (3) Food systems resilience in Uganda and (4) Food Systems governance in Kenya. Makerere University, through the Department of Geography, Geoinformatics and Climatic Sciences, in collaboration with the Swedish University of Agricultural Sciences and Lund University is implementing a project on Unlocking the Potential of Smallholder Farmers Urban Food Systems Resilience in Uganda Agriculture for Food Security (AgriFoSe2030).

The project is being implemented in two areas: Kasese municipality and Mbale city. The objectives of the project include: (1) Assessing the key vulnerabilities to urban food systems, (2) Facilitating a process of coming to agreement on the key priority areas and/or policies or actions and (3) Supporting decision makers to develop evidence-based policies and activities. Makerere University is the lead institution on the project, represented by the College of Agricultural and Environmental Sciences under the Leadership of Professor Frank Mugagga, Head Department of Geography, Geo-informatics and Climate Sciences.

AgriFoSe2030 project funds One (1) PhD student and two (2) masters students in the Department of Geography, Geoinformatics and Climatic Sciences. The project team led by Prof. Mugagga organized a two-day workshop as a follow-up on the mini survey conducted between 3rd and 9th October 2021, to ensure that smallholder farmers and decision makers within Kasese Municipality have a changed attitude towards smallholder farming and that decision makers recognize smallholder farmers as key players in the urban food risk reduction. The workshop was also intended to ensure that decision makers explicitly initiate processes and establish mechanisms through which smallholder farmers are able to fully participate as key stakeholders. The workshop was held from 13th to 14th December 2021, at Rwenzori International Hotel in Kasese Municipality.

AgriFoSe2030 Kasese Stakeholders' Workshop

Prof. Frank Mugagga engaging stakeholders during the Smallholder Farmers workshop in Kasese Municipality

xviii) Academia & Local Govt. Officials in West Nile Sensitized on Forestry & Biodiversity Conservation

Over 60 participants comprising academia, local government officials, the private sector and civil society organization on 2nd December 2021 converged at Muni University in Arua district to dialogue on the status of forests and bio diversity in West Nile region of Uganda. The policy dialogue was organized by EfD-Mak Centre in collaboration with Muni University and Arua District Local Government under the theme, "Forestry and Biodiversity: Addressing the challenges of Forest Degradation and enhancing Environment Management in Uganda". According to the Ag. Director EfD-Mak Centre Fred Kasalirwe, Arua was selected because of a lot of atrocities committed on nature in the region due to an influx of refugees. The representative of the Vice chancellor Muni University, Prof. Robert Kajobe who is Dean school of Agriculture and Environmental Sciences reported that degradation of the environment and forests in the region is relatively more that the national rate. West Nile region used to have two rainy seasons (March to May) and another longer one (July to November or up to early December) but in the last three years, the region has had one season of drought from December up to May.

Seated L-R: Arua LCV Chairman-Alfred Okuonzi, VC Muni University, Prof. Robert Kajobe and the RDC Arua, Ocen Robert pose for a group photo with participants after the opening ceremony on 2nd December 2021, Arua District

The Ag. Director EfD-Mak Centre Uganda Fred Kasalirwe presenting during the meeting

A section of participants attending the meeting

xixi) Mak DVCAA's visit to MaRCCI

On 5th February 2021, Makerere University Deputy Vice Chancellor in charge of Academic Affairs (DVC-AA), Dr Umar Kakumba visited the Makerere University Regional Centre for Crop Improvement (MaRC-CI). During his meeting with the Principal of CAES, Prof. Bernard Bashaasha and the Director as well as staff of MaRCCI and MUARIK, Prof. Kakumba commended MaRCCI for rendering a good service towards the strategic Vision and Mission of Makerere University. The DVC (AA) officially launched the MaRCCI website and toured facilities including the Biotechnology laboratory, the refurbished Gene Bank and the construction site for MaRCCI Office block and Lecture theatres.

Left: MUARIK Director Dr. Cyrus Okello Robert Ongom, Prof. Bernard Bashaasha, Prof. Umar Kakumba and Dr. Richard Edema visit the stall for sorghum and cowpea value added products
Right: DVC AA Assoc. Prof. Umar Kakumba (2nd) clicks the button to launch MaRCCI website

xx) Sasakawa Africa Association President's visit to Mak

Sasakawa Africa Association President (SAA) Dr. Makoto Kitanaka and several of his entourage from Tokyo Japan on 4th June 2021 visited Makerere University's College of Agricultural and Environmental Sciences (CAES) for a partnership meeting with the Department of Extension and Innovation studies(DEIS). The team discussed modalities of enhancing the universities capacity to engage with the community and also help women and youth to productively engage in Agriculture as a business. The team also shared what SAA has for Makerere in Japan and their strategic direction. They emphasized the need to promote sustainable, resilient and regenerative agriculture looking at integrated soil fertility management, Nutrition sensitive agriculture, promoting nutrient dense crops and skilling university and rural youth to do market-oriented agriculture and agribusiness. The meeting was graced by Regional Director SAA-Regional Office in Addis Ababa, Ethiopia, Dr. Mel Oluoch, SAA Country Director Uganda Dr. Roselline Nyamutale and her team.

xxi) Sasakawa Africa Association Donates IT Equipment to the Department of Extension and Innovation Studies

In 2021, the Department of Extension and Innovation Studies (DEIS) received an assortment of IT equipment for online training. The equipment was donated and delivered to Makerere University by the representatives of Sasakawa Africa Association on 2nd February, 2021. The equipment was handed over by the Country Director Sasakawa Africa Association Uganda, Dr. Roseline Nyamuntale and the Director Human Resource Department of Sasakawa Africa Regional Office Addis Ababa, Dr. Mercy Akeredolu.

Prof. Nelson Turyahabwe interacts with a staff member after receiving the equipment COVID-19 Vaccination

RESEARCH INSTITUTES

Makerere University Agricultural Research Institute Kabanyolo (MUARIK)

1. Introduction

MUARIK is one of the institutes of the College of Agricultural and Environmental Sciences (CAES), Makerere University whose role is to support CAES' teaching, research, outreach and production mandates. MUARIK started as a University Farm in 1953 and was later upgraded to a fully-fledged research institute in 1996. It is endowed with 230 hectares of land occupied by several crop and livestock units. The institute houses the Centre for Continuing Agricultural Education (CAEC), Makerere Regional Centre for Crop Improvement (MaRCCI), Centre of Excellence in Waste Management, Centre for Soybean Improvement and Development and the Consortium for enhancing University Responsiveness to Agribusiness Development Limited (CURAD). All these centres are run as independent units. MUARIK also has hostels that accommodate over 70 undergraduate and about 20 graduate students who stay at the institute to gain practical experience in research, in typical farming conditions. It also hosts regional graduate training programs in plant breeding systems with students drawn from different countries in the East and Central Africa region such as the Democratic Republic of Congo, Rwanda, Zambia, Zimbabwe, Tanzania to mention a few. MUARIK also offers student tour services for both lower and higher institutions of learning. It further serves as a center for experiments and practical work for research projects based at the College of Agricultural and Environmental Sciences. Currently, there is ongoing research on edible insects, worms as alternative feed for livestock, agroforestry, and food processing and value addition for value chain improvement among others.

2. General Structure of MUARIK

Functioning of MUARIK

The major mandates of MUARIK are training, research and outreach. As part of the National Agricultural Research System (NARS), MUARIK carries out research based on national priorities. These include biotechnology, tissue culture technology, plant breeding, development of improved farming techniques, agro-processing, marketing and value addition. With regard to outreach, MUARIK offers on-spot technical advice to the farming community. Outreach activities mainly focus on schools and farmers. In a year over 600 primaries, secondary, and tertiary schools with a total population of about 30,000 visit MUARIK. The institute undertakes production of a wide range of crops and livestock. Although these units are primarily for commercial production, they are used to teaching, research and outreach activities.

Other important units housed at MUARIK include, a health clinic under the university hospital, students hostel headed by the Warden under the university Dean of Students, security unit under the university security unit, a police post under the under the Uganda Police, Agricultural Engineering workshop under the Department of Agricultural and Bio-system Engineering, Animal and crop laboratories, green houses as well as a goat unit under the Department of Agricultural Production, among others.

3. Management of MUARIK

MUARIK policy committee is the body in charge of MUARIK management and reports to CAES management council. This committee is comprised of the following members:

1. The Principal (Chairman)
2. Director MUARIK (Secretary)
3. Prof. Jacobs Agea, SAS
4. Prof. Jonny Mugisha, SAS
5. Dr. Alice Amoding
6. Dr. Bernard Obaa
7. Assoc. Prof. Fred Babweteera
8. Dr. Ampe Gaston Tumuhimbse
9. The Farm Manager

The day to day management of MUARIK is run by MUARIK management committee that reports to the Principal and MUARIK policy Committee. The members on this committee are:

1. The Director (Chairperson)
2. The Farm Manager (Secretary)
3. Assist. Farm manager (Crops)
4. Training Coordinator
5. Head Security
6. Head, Police Unit
7. Mechanization and workshop unit head
8. Stores Assistant
9. General workers' supervisor
10. Head of Dairy Value chain (DVC) Unit
11. The institute accountant

The dairy value chain (DVC) also has a steering committee with following membership:

1. Principal, Chairman
2. Director, Secretary
3. DVC Coordinator,
4. Mrs Beartice Byaruhanga, MAAIF
5. Mr. Kanyike, Dairy farmer
6. Dr. Dennis Mpairwe
7. Dr. Justine Nambi
8. Mr. Kisirinya , Private Sector Foundation
9. Representative from Dairy Cooperation

4. Enterprises at MUARIK, their status and challenges

MUARIK is endowed with good soils, pasturelands, wetlands, woodlots (agroforestry, pine and eucalyptus), fish pond, rivers and a valley dam, all sitting on 230 hectares of land. A summary of the enterprise at MUARIK and brief notes about them is given in table 1 below:

Table 8: Enterprises at MUARIK

No.	Enterprise	Status	Comment/Status/Challenge
1	Pastures	Active	• A promising enterprise • Producing is less than market demand • The unit currently has positive margins
2	Dairy	Active	• This covers the whole dairy value chain from pasture/ feed production to milk processing • It has staffing challenges • It faces insufficient investment capital: Currently has negative margins due to under investment • Milking and processing equipment was procured under the ADB HEST project. A milking parlor has been installed. A shed for installation of some of the equipment is under construction.
3	Feed mill	Active	• The feed mill was renovated and revamped under ADB HEST Project. It is currently being used by the KOICA/IBS for production of poultry feeds. • This unit has very high potential for income generation but lacks investment capital
4	Silage business	Active	• This unit is used occasionally for MUARIK dairy unit use only • It is generally underutilized • There is high market potential for silage
5	Study tours and learning	Active	• This is a potential high income generator for MUARIK. • It had the highest annual income contribution to the institute before COVID 19 affected the visits
6A	Poultry 1	active	• The facilities have been renovated and stocked. • Lack of technical skills for the ground staff has made it very difficult to realize profits.
6B	Poultry 2	Active layers	15,000 layers: Operated under an MOU between CAES and Chonbuk National University, International Agriculture Program and Cooperation Centre- MOU signed on March 5th 2018.
7	Piggery	Active	• The piggery unit is one of the most potentially profitable units if investment and re-equipment is done. • It has a potentially high and quick return on investment. • It has been very difficult to run profitably due to lack of skilled labor, thefts and limited capital • There need to re-stock better breeds, get skilled labor, and add capital

8	Banana	Active	• This plantation has been improved to a great extent • Acreage has been increase from 7 acres to 14 acres • The market for the banana is ever sure • There is a challenge of thieves · It is labour intensiveness and suffers in face of labor shortage
9	Annual crops (Maize, soybean)	Active	• Mainly maize and soya bean are grown • It has been very challenging due to shortage of labor and pests especially the fall army worm
10	Horticulture and floriculture(Passion Fruits, vegetables, flowers	Closed for MUARIK	• There is one screen house available for demonstration to students/farmers • The prospects are very high for this section but a lot is needed: Requires hiring skilled labor • Has an established a mango fruit mother garden with financial support from Principals office • Some of the crops that can be grown are passion fruits, flowers, tomatoes and other high value crops
11	Fish farming	Closed	• This was also closed due to lack of staff and resources • It needs to be re-opened as it can potentially generate a lot of funds.
12	Rabbit	Closed	• This was closed. • Lack of staff was the main challenge.
13	Coffee	Open	• The 6 acres coffee plantation has a lot of prospects • There's lack of adequate labor and skills to effectively maintain. • This unit is not profitable at the moment
14	Goat farming	Closed for MUARIK	• Lack of staff was the main challenge.
15	Forestry	Open	• 4 acres of eucalyptus and 4 acres of pine trees • Termite damage is a big challenge • There is need to recruit more skilled labour to maintain the plantations

5. Recent Achievements at MUARIK

Increase banana plantation acreage: MUARIK has expanded the banana plantation and planted seven additional acres of a new plantation. The total acreage now stands at about 14.

Renovation activities: With facilitation from CAES, MUARIK has commenced renovation activities for the poultry unit which had been closed due to the poor state of the buildings and other structures at the unit to improve efficiency and quality of training.

Soybean production: MUARIK has partnered with the Makerere University Centre for Soybean Improvement and Development, to become one of the out-growers. The acreage of the soya bean has doubled from 7 acres to 14 in the period 2018-2020.

Pasture gardens expansion: To increase income and ability to feed animals, MUARIK has planted 20 acres of Chloris Gayana pasture and 5 acres of elephant grass. This was done with the aid of funds from the ADB HEST project. This commercial pasture growing has increased the farm revenue from both seed production, hay making. Sales from hay and pasture seed, as well as feeding of the livestock have improved.

Stores records: In stores, records have been put in place and updated regularly. Requisition books, material transfer note book, bin cards and registers have been put in place. Accountability has improved as a result of ensuring that funds advanced to users are spent appropriately and items bought are received, checked, recorded and issued following store management procedures. The MUARIK store is now an independent unit.

Coffee plantation improvement efforts: Although the coffee plantation maintenance and quality of the crops is still a challenge, MUARIK has created an arrangement for MUARIK workers to weed the whole coffee plantation and plant annual crops as they maintain the plantation.

Elimination of illegal water connections: In the plumbing section, MUARIK has been able to discover and disconnect five long standing illegal water connections with heavy consumption (included a school) to establishments neighbouring MUARIK. This has helped to regularise the supply of water to MUARIK units. New water lines have also been extended to units.

Hosting of schools and institutions: The training mandate of the institute has shown great potential, and before the COVID 19 pandemic, the training component was generating aver 40% of the institute's revenues. In 2019/2020, MUARIK hosted 225 schools, and raised about 32 million Uganda shillings from study tours and service learners. For study tours, MUARIK trained 8,068 students, while 153 service learners were trained.

Student and staff projects: MUARIK has also hosted several student and staff projects. Table 2 provides a summary of undergraduate student projects, while table 3 indicates graduate research projects and the respective researchers.

Table 9: Summary of the undergraduate student projects at MUARIK

CROP	NO OF STUDENTS
Mashroom production	03
Poultry	03
Soybean	10
Hot pepper	05
Tomatoes	01
Pasture	01
Horticulture	01
Green house	06
Cassava	01

Table 3 indicates projects for Masters, PhD students and researchers that support the institute to feed into the National Research System

Table 10: Graduate research projects initiated in 2019-2020

No	Name of researcher	Project
01	Dr. Fred Kabi	- Waste management - Unearthing the potential of Earthworms
02	Prof. Philip Nyeko	- Grass hoppers
03	Mr. Kyeyune	- Mushroom production
04	Dr.Edema Richard	- Cereal/ legumes (sorghum and cowpeas)
05	Prof. Dorothy Nakimbugwe	- Edible insects

6. Partnerships

MUARIK has MOUs with several institutions. These include:

- Chonbuk National University International Agriculture Development and Cooperation Center
- Monitor Publications Ltd.
- Consortium for enhancing University Responsiveness to Agribusiness Development Limited (CURAD)
- The Hive Uganda
- Mbuye Farm, Sese institute.

7. Staff at MUARIK

MUARIK currently employs a total of 59 workers. A list of the workers at MUARIK is shown in table 4 below.

Table 11: List of Staff working at MUARIK

No.	Name	Title	Status	Paid by
1	Dr. Cyrus Okello Ongom	Director	Permanent	University
2	Mr. Leo Natamba	Farm Manager	Permanent	University
3	Mr. Banjwa H. Samuel	Asst. Foreman	Permanent	University
4	Mr. Okello Richard	Carpenter	Permanent	University
5	Samanya Alex	Tractor driver	Permanent	University
6	Kiwanuka Robert	Tractor driver	Permanent	University
7	Musoma Moses	Driver	Permanent	University
8	Musisi Vincent	Sanitary Cleaner	Permanent	University
9	Ntongo Edith	Sanitary cleaner	Permanent	University
10	Mwanda John	General Farm Worker	Permanent	University
11	Mutungire Bowers	General Farm Worker	Permanent	University
12	Toko George	General Farm Worker	Permanent	University
13	Kaaja Yusuf	General Farm Worker	Permanent	University
14	Nabwire Immaculate	General Farm Worker	Permanent	University
15	Male Stuart	General Farm Worker	Permanent	University
16	Nambaziira Harriet	General Farm Worker	Permanent	University
17	Musisi Godfrey	General Farm Worker	Permanent	University
18	Nambooze Joyce	General Farm Worker	Permanent	University
19	Byekwaso Denis (Retires 25th January 2021)	General Farm Worker	Permanent	University

20	Ssentamu Godfrey	General Farm Worker	Permanent	University
21	Sekalyowa Joseph	General Farm Worker	Permanent	University
22	Nabisubi Kasifa	General Farm Worker	Permanent	University
23	Namutebi Annet	General Farm Worker	Permanent	University
24	Nuwagaba Abias	General Farm Worker	Permanent	University
25	Ndezaho Godfrey	General Farm Worker	Permanent	University
26	Nandawula Margret	General Farm Worker	Permanent	University
27	Nanfuka Harriet	General Farm Worker	Permanent	University
28	Zaguma Godfrey	General Farm Worker	Permanent	University
29	Twesigye Moses	General Farm Worker	Permanent	University
30	Balyejjusa Samuel	General Farm Worker	Permanent	University
31	Owor Julius	Security	Permanent	University
32	Ambayo Bosco	Security	Permanent	University
33	Draluma Godfrey	Security	Permanent	University
34	Mugisa Davis	Security	Permanent	University
35	Candia Patrick Oleya	Security	Permanent	University
36	Kiggundu Geoffrey	Security	Permanent	University
37	Nandulya Masala Paul	Security	Permanent	University
38	Kasaja Peter	Security	Permanent	University
39	Agaba Issa	Herd man	No Contract	MUARIK
40	Ajawo William	Security	No Contract	MUARIK
41	Akankwasa Julius	Horticulture	No Contract	MUARIK
42	Aruho Benon	Feed Mill attendant	No Contract	MUARIK
43	Atiku Kennedy	Security	No Contract	MUARIK
44	Bagyenyi Marrk	Herd man	No Contract	MUARIK
45	Bareba John	General Farm Worker	No Contract	MUARIK
46	Byaruhanga Richard	Herd man	No Contract	MUARIK
47	Eimani Stella	Laboratory Cleaner	No Contract	MUARIK
48	Kalenzi Festo	General Farm Worker	No Contract	MUARIK
49	Kaliisa Julius	Banana Plantation Att.	No Contract	MUARIK
50	Muguruka Lugard	Accounts and Logistics	Contract	MUARIK
51	Nabukalu Racheal	Office Secretary	No Contract	MUARIK
52	Nakigozi Annet	General Farm Worker	No Contract	MUARIK
53	Nalugoye Grace	General Farm Worker	No Contract	MUARIK
54	Namwanje Robinah	General Farm Worker	No Contract	MUARIK
55	Nanfuka Sarah	General Farm Worker	No Contract	MUARIK
56	Nuwagira Saxson	Plumber	No Contract	MUARIK
57	Philip Basasibwaki	Zero grazing attendant	No Contract	MUARIK
58	Ssemambo Joseph	Piggery unit	No Contract	MUARIK
59	Taremwa Precious	Coordinator	Contract	MUARIK

8. Challenges at MUARIK

i) STAFFING

MUARIK's staffing challenges stem from both lack of sufficient numbers and lack of technical skills. For a long time, MUARIK's workers who retire or get transferred have not been replaced. This greatly contributes to low levels of production, and high levels of inefficiency including thefts. Thefts due to lack of sufficient security are mainly from

without the farm. University property and resources are also liable to theft from within due to lack of enough staff to create checkpoints within the institute system. There is need to re-equip the institute with skilled staff. To fill some of these gaps temporarily, MUARIK has resorted to hire of temporary staff, which is very expensive. Table 6 below show the number of staff existing at MUARIK compared to the number required at the institute.

Table 12: Staffing needs at MUARIK

Position Name	Required No. staff	Filled	Temporary arrangement	Retired	Resigned	Death	Vacant	Deficit
Director	1	0	1	-	-	-	-	0
Farm Manager	1	0	0	1	-	-	1	1
Assist. Farm Manager	4	-	-	-	-	-	-	4
Accounts clerk	1	-	1	1	-	-	-	1
Secretary	1	0	0	1	-	-	-	1
Foreman	7	1	0	6	-	-	7	7
Assistant Foreman	14	0	0	14	-	-	14	14
Headman	1	0	1	1	-	-	1	1
Plumber	2	0	1	1	-	-	2	2
Electrician	2	1	0	1	-	-	1	1
Poultry Attendant	4	0	0	-	-	-	4	4
General Farm workers	160	28	6	-	-	-	130	130
Security	11	8	1	-	-	-	2	2
Receptionist /Office messenger	1	0	-	-	-	-	1	1
Cleaners	2	0	0	-	-	-	2	2
Sanitary cleaners	2	1	0	-	-	-	1	1
Stockman	2	0	0	-	-	-	2	2
Messenger	1	0	0	-	-	-	1	1
Driver	2	1	0	1	-	-	1	1
Tractor operator	2	2	0	-	-	-	0	0
Turnboy	1	0	0				1	1
Recorder	2	2	0	-	-	-	0	0
Store keeper	2	1	0	-	-	-	1	1

Mechanic	2	0	0	2	-	-	2	2
Herdsmen	4	0	3	-	-	-	4	4
Feed mill Technician	1	0	0	-	-	-	1	1
Training coordinator	2	0	0	-	-	-	2	2
Total	**235**	**45**	**14**	**29**	**0**	**0**	**181**	**187**

ii) Encroachment on MUARIK land

Encroachment on MUARIK land takes several forms: Shifting of boundaries by encroachers, unauthorized use and expansion of initially offered land without authorization and disputed ownership of sections of land. Some tenants at MUARIK who were initially given land, and the tenancy period expired, have declined to vacate the land. There is urgent need to re-survey all land at MUARIK and put clearer, more prominent boundaries/poles. In addition, it will be necessary to send teams on scheduled tours of the borders to ensure security and non-encroachment.

iii) Poor financial status

MUARIK's financial status is challenging and derails all efforts to operate efficiently. The institute has no budget vote from the center. Because of this, there is under-investment in units that would otherwise generate profits. These are currently underperforming, many in the negative as shown in table 5. Many of MUARIK's units are operating below break-even because of lack resources to invest and upgrade the units. It is also not possible to maintain infrastructure due to limited resources. Maintenance, repair and service of equipment is also regularly affected by lack of funds. There is need to have a budget for MUARIK from the center to allow sufficient investment in units with high potential. Alternatively, all units need to be evaluated, levels of investment required established, and then financed accordingly, in order to support themselves.

iv) Unclear policies on use of MUARIK infrastructure

There is need for clear guidelines to both MUARIK and sister department on use of MUARIK facilities. Such can include rules on changes on buildings (e.g. renovations), fees to be paid for land use, cutting/planting of trees, painting of crops beyond one season, among others.

9. Opportunities at MUARIK

MUARIK presents numerous opportunities:

Land resources: The large acreage at MUARIK totaling 230 hectares (562.5 acres) has high potential for training students in a variety of crop, forestry and animal enterprises including development of skills using the existing wood and metal workshops.

Proximity to urban area and to NaCRRI: MUARIK has excellent access to a ready market with good a road connection to both Kampala city and NARO's National Crop Research Resources Institute at Namulonge.

Academic and support staff: MUARIK has access to CAES's technical staff with much endowment of skills and knowledge in the fields of agriculture, food, forestry and environmental sciences. MUARIK has an excellent opportunity to use these skills by engaging in profitable enterprises for food production, value addition and environmental management to make a significant contribution towards food and nutritional security at Makerere University and the country.

Outreach: The farm usually receives pupils and students interested in physical observation of machinery, tools, forage, weed, pests and diseases specimen that are covered and school curriculum but not easily available in schools. The farm also receives farmers and other visitors interested in learning how to produce organic pigs, coffee and fruit tree seedlings, flowers, grafting, mixing feeds, produce hay bales, compost manure, and local/crossed chicken. Some companies promoting new crop varieties, agrochemicals are interested in establishing roadside demos.

Proposed short training courses: Due to high demand of short duration training in the field of general Agriculture, a training program focusing holiday makers, school drop outs, famers and general public interested in Agriculture can be started.

10. Critical areas for improvement

To keep MUARIK standards and expectations, the following issues need to be urgently addressed:

Renovation of roads and buildings, including improvement of all infrastructure, and internet access.

Safe guarding of land borders: This is critical and urgent as the land boundaries are insecure on all sides

Improved staffing with skilled labour: The number and skill levels of staff need to be improved. Recruitment should be very specific with the required skills in order to beef up the technical knowhow of the current work force.

Financing of units to required minimum capital. Units at the institute will only cover their running costs if intentional investments are done. There is need to conduct investment analysis of the units. Under investment is leading to sinking of resources.

Inclusion of MUARIK on the university budget: MUARIK needs to be included in the university central budget in order to be able to run efficiently as a teaching and research institute.

Prioritization of the research arm of MUARIK: Currently the institute does not have core researchers but hosts research of staff and students from the main campus. Ongoing research in the Departments at CAES as well as all research projects running at the institute are largely delinked from crop and livestock production processes and activities at MUARIK.

For MUARIK to take up and consolidate its position in agricultural research it will require recruitment of full time scientists dedicated to core research at MUARIK. Alternatively, academic staff should be identified and mandated to dedicate a percentage of their time to research at MUARIK.

FACILITIES OF MUARIK















THE MAKERERE UNIVERSITY BIOLOGICAL FIELD STATION (MUBFS)

MUBFS is located in Kibale National Park in Kabarole and Kamwenge districts. It is mainly involved in research but it is increasingly hosting short international courses in Tropical Biology. Originally, most of the research at MUBFS was primatology but over the years, the research agenda has broadened to include ecological and behavioral research on taxonomy, and socio-economic studies.

There is adequate dormitory and guest house space for groups ranging between 10 and 60 and catering services. In collaboration with national institutions, the institute provides consultancy services to the government and other organizations in Uganda. Consultancy services include tailor made training in different fields of environment and natural resources, assessment and monitoring of environment and natural resources therein environmental impact assessments and audits, project monitoring and evaluation and facilitation.

1.Background

Makerere University Biological Field Station (MUBFS) is a unit of the College of Agricultural and Environmental Sciences (CAES) located in Kibale National Park, Kabarole district. The station has two research sites in Kibale National Park and accessed through a Memorandum of Understanding between CAES and the Uganda Wildlife Authority. The current

MoU covers ten (10 years) and was signed on the 11th of November 2015. The main research site is located at Kanyawara at the edge of Kibale National Park about 16 Kilometres from Fort Portal town while a smaller camp is located in the heart of the park at Ngogo. Both sites are easily accessible by road and users of the station facilities are charged fees as per the established structure (Appendix I). With the tremendous species diversity in Kibale National Park, the station offers endless research opportunities. It is mainly known the world over for its research track record on primates notably: chimpanzees (Pan troglodytes), the red colobus monkeys (Procolobusrufomitratus), Blue monkeys (Cercopithecus mitis), red tail monkeys (Cercopithecus ascanius), gray-cheeked mangabey (Cerocebusalbigena), and black-and-white colobus (Colobus guereza). However, research interests have expanded beyond primates to include: (1) ecological and behavioral studies of other taxa including fish, birds, insects, and amphibians; (2) forest regeneration; (3) long-term ecological monitoring, including climatic monitoring, plant honological patterns, swamp and river limnology, fish populations; and (4) socio-economic and socio-ecological studies, including studies of the effects of animal crop raiding and human-wildlife interactions.

2. MUBFS Mission Statement

MUBFS Mission Statement is as follows:

Makerere University Biological Field Station is committed to undertaking and providing opportunities for high quality, multi-disciplinary research and education in tropical ecosystems, with the underlying objective of contributing to the conservation and development needs of Kibale National Park and its surrounding ecological and human communities.

The mission hence fits well in the Makerere University's strategic plan and long term desire of being a "Research Driven University Emphasizing Knowledge Transfer Partnerships and Networking".

3. Research activities at MUBFS

Research at MUBFS can be carried out with attachment to any of the two main study sites, but the MoU between Uganda Wildlife Authority and Makerere University allows MUBFS' researchers to conduct research outside these two designated sites.

There are a number of on-going research projects by local and international scholars including research on:

- Ecological and Behavioral studies of various primate species
- Forest regeneration in logged and formerly encroached areas.
- Long-term ecological monitoring of Kibale National Park Ecosystems.
- Socio-Economic and ecological studies including crop raiding by park wildlife.
- Disease transmission among wildlife, domestic animal and humans
- The recovery of biodiversity in tropical rainforests following human-induced disturbance (Using insects as indicators)
- The nutrition of primates in Kibale National Park

4. Human Resource

The establishment of MUBFS has 36 positions, but of these only 05 and 20 are filled on permanent and contract terms respectively as indicated in Table 1 below, with most being on contract terms and paid locally within the budget of MUBFS.

Table 13: Summary of the Human resource at MUBFS

NO.	POSITION	NAME	CONTRACT TYPE
1	Director	David Mwesigye Tumusiime	Permanent
2	Accountant	Herbert Tumukunde	Permanent
3	Librarian	Janet Tumushabe	Permanent
4	Clerk Of Works	Berunga Winifred	Permanent
5	Assist. Domestic Bursar	Kato Innocent Mwesige	Contract
6	Security Guard	Kasaija Ebenezer	Contract
7	Security Guard	Mugisa Expedito	Contract
8	Security Guard	Andrew Byaruhanga	Permanent
9	Trail Cutter	Rutenta Wilson	Contract
10	Trail Cutter	Bamukusa Francis	Contract
11	Trail Cutter	Nyakahuma Richard	Contract
12	Trail Cutter	Atuhaire Samuel	Contract
13	Trail Cutter	Birungi Charles	Contract
14	Trail Cutter	Katuramu Clovis	Contract
15	Trail Cutter	Kisembo Vicent	Contract
16	Headman	Kugonza Robert	Contract
17	Trail Cutter	Kusemererwa Charles	Contract
18	Driver	Kyalimpa Wilson	Contract
19	Trail Cutter	Tibeya Adolphus	Contract
20	Trail Cutter	Zahura James	Contract
21	Trail Cutter	Sabiiti Charles	4-Year Contract
22	Cook	Kakyo Malyamu	Contract
23	Driver	Sembatya Paul	Contract
24	Messenger	Tumusiime Yosinta	4-Year Contract
25	Store Man	Kemigisa Patience	Contract

5. Finances of MUBFS

Makerere University Biological Field Station (MUBFS) generates revenue from users of the station facilities that is deposited to the collection account of the Uganda Revenue Authority. Expenditure is based on budget approved by Makerere University and allocated through IFMIS (Table 2).

Table 14: Summary budget expenditure for 2020/2021

S/N	Expenditure Item	Research	Administrative	Total
1	Salaries and Allowances		175,026,000	175,026,000
2	Social contributions		20,052,000	20,052,000
3	Incapacity death and benefits and funeral expenses		2,000,000	2,000,000
4	Advertising and public relations		2,800,000	2,800,000
5	Staff Training	2,000,000		2,000,000
6	Research	12,740,000		12,740,000
7	Books and periodicals /Library	1,488,000		1,488,000
8	Computer Supplies and Information Technology (IT)	3,700,000		3,700,000
9	Welfare entertainment		14,188,200	14,188,200
10	Printing stationary, Photo copying & Binding	1,537,000		1,537,000
11	Telecommunications		4,620,000	4,620,000
12	Postage and courier		200,000	200,000
13	ICT Band Width	1,200,000	2,160,000	3,360,000
14	Electricity		12,000,000	12,000,000
15	Water		960,000	960,000
16	Cleaning and Sanitation		974,000	974,000
17	Travel inland		6,408,000	6,408,000
18	Fuel oil and lubricants		23,360,000	23,360,000
19	Maintenance civil		26,948,000	26,948,000
20	Maintenance Vehicles		15,770,000	15,770,000
21	Maintenance other		5,443,000	5,443,000
22	Scholarships and related costs	53,168,600		53,168,600
Total Expenditure		**75,833,600**	**312,909,200**	**388,742,800**

6. Achievements

The field station has progressively made several achievements and here below is a summary of some of the most recent ones.

Continuation of long-term data collection

In line with its mission, MUBFS continues to collect data on a variety of aspects of the Kibale tropical ecosystem and its surrounding human community. These include:

(A) Censuses of all primate and terrestrial mammal densities, including elephants. We have a 50+ year record of population dynamics of primates and 30-year record for elephants. These results are extremely positive as the abundance of all of the populations that we have monitored have increased.

(B) Monitored changing leaf, flowering, and fruiting patterns of tree species used by primates and terrestrial mammals, for which we have continuous data since 1970.

(C) Monitoring of elephant movement through genetically identifying individuals by sampling DNA in the dung and by following track of groups after then leave a crop raiding site. We have been successful at getting DNA from elephant dung already (Omeja et al. 2017). Trials at following tracks have been successful at following crop raiding individuals for up to 3 km into the park.

(D) Continuation of the collection of behavioral data on the Chimpanzee and Monkey communities at Kanyawara and Ngogo areas.

Publications

Over 500 research papers and book chapters have been published from research conducted at MUBFS. These are all available in our library and can be accessed online.

Improved online presence

The field station has obtained a domain from DICTS and created a website https://bfs.mak.ac.ug/ which has improved online presence. This has been handy during the Covid-19 lockdown and improved visibility of the station. Given the contacts initiated through this medium, it is hoped that there will be more opportunities for collaborative activities in research, training, and community outreach in the near future.

Budget allocation

The station has since the 2019/2020 financial year been given a budget allocation by Makerere University.

Improved relevance of the station to Mak

Over the years, the field station has improved its relevance to Mak through hosting field courses and internship for students from the Colleges of Agricultural and Environmental Sciences (CAES), Natural Sciences (CONAS), COVAB and CEES.

The field station is also a popular site for student research for MSc. and PhD studies. For instance, in the last graduation two students were supported and conducted their studies at MUBFS:

1. Ms. Anke Barahukwa: The effect of Lantana camara l. on the recovery of a moist semi-deciduous forest at Mainaro, Kibale National Park, Uganda

2. Ms. Anna Muchwampaka:Factors influencing farmers' willingness to pay for reduction in human-wildlife conflict around Kibale National Park

3. Mr. Emmanuel Abwa has also prepared his thesis on Rural livelihood diversification on food insecurity in the area around Kibale National Park and is under examination.

7. PhD studies

Two PhD students are undertaking their PhD studies, based at MUBFS:

1. Mr. Samuel Angedakin

Manager Ngogo Chimpanzee Project Research area: Conservation and livelihood impacts of long-term research presence in an African tropical rainforest

2. Mr. Wilson Kagoro

Research area: Adaptive management as a tool for sustainable conservation of protected areas: Case study of Kibale National Park, Uganda

Further, two PhD candidates have been hosted by MUBFS to write up their theses

3. Mr. Christopher Mawa

Mr. Mawa has been hosted by the field station during the writing of his PhD thesis on Effects of tenure arrangements on forest conservation and rural livelihoods in Mid-Western Uganda. The thesis has since been completed and is scheduled for public defense.

4. Ms. Kemigisha Esther

Mr. Kemigisha has been hosted by the field station during the writing of her PhD thesis. The writing is on-going.

8. Surveying of the University Land at MUBFS

The land on which MUBFS' two research sites sit belongs to the Uganda Wildlife Authority and MUBFS uses it through a Memorandum of Understanding. However, in addition MUBFS has purchased own land that belongs to Makerere University. The land has been surveyed by the Estates Department of Makerere University (Table 3) and the process of acquisition of tittle deeds is on-going.

Table 15: Land owned by MUBFS and covered by tree plantations

S/N	Description	Physical Location	Date of Acquisition	Acres
1	Tree Plantation-Parcel 1	MUBFS-Kanyawara (Kabarole District)	1994	9.306
2	Tree Plantation-Parcel 2	MUBFS-Kanyawara (Kabarole District)	1994	1.829
3	Tree Plantation-Parcel 3	MUBFS-Kanyawara (Kabarole District)	1994	2.182
4	Tree Plantation-Parcel 4	MUBFS-Kanyawara (Kabarole District)	1994	7.392
5	Tree Plantation-Parcel 5	MUBFS-Nkingo (Kamwenge District)	1994	18.82
6	Tree Plantation-Parcel 6	MUBFS-Nkingo (Kamwenge District)	1994	0.411
7	Tree Plantation-Parcel 7	MUBFS-Nkingo (Kamwenge District)	1994	0.3
				40.24

9. More Collaborations Initiated

MUBFS continues to expand collaborations with other national and international institutions. Some of the latest collaborations include:

1. Canada-South Africa trilateral Research Chair in climate change and human-wildlife interactions (2018 – 2023)

The collaboration, funded by The International Development Research Centre (IDRC – Canada), is a trilateral partnership between Makerere University, McGill University, and the University of KwaZulu-Natal in South Africa. It focuses on human-wildlife interactions, involving the rural poor people and how they are affected by climate change and aims to predict how climate change will exacerbate human-wildlife conflicts, and design and test measures to mitigate climate change impacts on the rural poor and wildlife. The collaboration has already funded by MSc. Students and one on-going PhD study.

Within this collaboration, we have developed an elephant odor gun, that can spray an aerosolized liquid into the air and the smell of that liquid spreads rapidly. The gun is made of locally available PVC pipe, and with the exception of a 25 cent washer, can all be bought and easily build in Uganda. With the aid of an Evolutionary Chemist at Ulm University in Germany we have developed a number of scents that elephants should not like (none would hurt the animals or children if they were exposed to them or sprayed in the eye). We have permission to test what chemical the elephants appear to find very disgusting and move away from for a captive group of rehabilitant elephants in South Africa.

Max Planck Institute of Animal Behavior, Germany (2021-2023)

The collaboration seeks to further research programs for the study of the behavioural ecology of non-human primates in and around Kibale National Park and at Makerere University Biological Field Station. The collaboration is already nurturing one former student of the Department of Environmental Management, Mak, for long term field research of the red colobus monkey.

Community-based design research – Washington University, St.Louis(2021-2024)

A community-based design research project is being undertaken in partnership with people who live near Kibale National Park and the goal is to craft messages and symbols that will reinforce positive and safe human-wildlife interactions.

10. Contribution to the Conservation of Kibale National Park

MUBFS researchers work hand in hand with UWA to protect the forest reporting any illegal activities encountered in the forest. Further, the presence of the MUBFS researchers who cover large expanses of the forest helps to deter would-be participants in illegal activities. Also, our Kibale Snare Removal Project working in collaboration with Uganda Wildlife Authority (UWA) has helped to reduce illegal activities, especially snaring. As predicted, illegal activities increased due to the lockdown with 700% increase in April and May. However, this was quickly curtailed by aggressive joint patrols organized by UWA.

11. A growing community outreach program

Working through its outreach arm, MUBFS undertakes conservation education amongst local communities and also directly supports formal education. Further, the Kibale Forest Schools Program (KFSP) conducts Health and Conservation education in 16 Government-aided Primary schools that are within 5Km of the western side of Kibale National Park.

12. Challenges

12.1 Limited Human Resource

MUBFS has a number of vacant yet established positions and many of which are critical (Table 4). For example, the trail cutters are inadequate to maintain 8 acres of compounds, 25 km of access roads, 170 km trail system at Kanyawara, and 60 km trail system at Ngogo. It is important to note that this trail system must be maintained for easy and reliable access to the interior of the forest, which makes MUBFS a popular site for field courses and long term research activities. Many of these trails also serve as boundaries of long term plots for monitoring vegetation changes in the forest, some stretching as far back as 1975.

Table 16: Current vacant positions at MUBFS

POSITION	NO
Research Fellow	01
Admin Assistant	01
Accountant	01
Domestic Bursar	01
Secretary	01
Assistant Chef	01
Cooks	01
Driver	01
Trail cutter	13
Headman	01
Guard	03
TOTAL	**26**

12.2 Employment status of most staff

Most of the staff at MUBFS are on contract terms and paid for within the budget allocation to the field station. As a result, most of the budget allocation goes to payment of the employee salaries and wages leaving little money to fund other activities.

12.3 Limited Facilities for Accommodation

MUBFS continues to be a popular place for researchers and other users, but during peak times the station struggles and in some instances has failed to accommodate its visitors on site. There is need therefore to increase capacity to accommodate more users.

12.4 Disposal of Obsolete Items

The station has a number of obsolete items that need to be disposed of through proper university channels so as to free space currently occupied by these items, but also where possible to recover some monies.

12.5 Remoteness from Main Campus

Due to remoteness from the main campus, the University Administration tend not to appreciate the Station existence and needs e.g. the US recently cancelled a procurement of slashers, workers boots and rain coats as being 'Not Required'.

Further, procurement remains a challenge because many of the would be suppliers in the Kabarole area are not pre-qualified and the station is expected to use the same pool of suppliers as the main Campus. Responsiveness of the later suppliers when selected has many times been low.

RESEARCH INFRASTRUCTURE

Table 17: School of agricultural sciences (sas) – laboratories

NO.	NAME OF THE LAB	STATE OF LAB (Good / poor)	CAPACITY (Number of users)
1.	Soil Science East Laboratory	Poor	40
2.	Soil Science Research Laboratory	Good	20
3.	Soil Science General Laboratory	Poor	45
4.	Crop Science Laboratory	Good	40
5.	Animal Science Nutrition Laboratory	Good	30
6.	Central Biotechnology Laboratory	Good	20
7.	Soil Science BNF Laboratory	Good	05
8.	Tissue Culture Laboratory MUARIK	Good	40
9.	Biotechnology Laboratory MUARIK	Good	40
10.	Gene bank, MUARIK	Good	-
11.	SAS undergraduate computer Lab (with 10 computers)	Poor	40
12.	SAS Graduate Computer Lab (with 09 computers)	Poor	20
13.	Kabanyolo Computer Lab (with 05 computers)	Poor	36
14.	GIS Lab (with 08 computers)	Good	10

Table 18: School Of Forestry, Environmental And Geographical Sciences (SFEGS) - Laboratories

NO.	NAME OF THE LAB	STATE OF LAB (Good / poor)	CAPACITY (Number of users)
1	The Remote Sensing and GIS Laboratory	Good	40
2	The Molecular Biology Laboratory	Poor	
3	The Water and wetlands research Laboratory	Very poor	03
4	Undergraduate students lab (with 15 computers)	Fair	25
5	Graduate lab without computers	Very poor	10
6	Geography lab (with 16 computers)	Very Good	40
7	Modelling Lab (with 10 computers)	Very Good	10
8	Environment Computer lab(with 4 computers)	Poor	20

Table 19: School Of Food Technology, Nutrition And Bioengineering (SFTNB) - Laboratories

NO.	NAME OF THE LAB	STATE OF LAB (Good / poor)	CAPACITY (Number of users)
1	Food Science Chemistry Lab	Good	30
2	Food Science Micro Biology Lab	Good	20
3	Food Science Nutrition Lab	Fair	10-15
4	Food Science undergraduate computer lab (with12 computers)	Fair	40

HUMAN RESOURCE FUNCTION

The College has a total of 373 members of staff, both teaching and non-teaching. In the year under review, several members staff were promoted to various academic ranks as indicated in the tables.

MAK-FTBIC Gets New Manager

Dr. Yusuf Byaruhanga

In mid-2021, the Food Technology and Business Incubation Center got Dr Yusuf Byaruhanga as its new Manager after the retirement of Prof. William Kyamuhangire. Before coming in as a manager Dr Byaruhanga served as FTBIC Liaison Officer and Coordinator of the Skills Training Program for Small and Medium Enterprises. He brings on board a wealth of skills and experience in technology and business incubation as the center continues to make tremendous contribution to the growth and development of Uganda's food industry. MAK-FTBIC is Uganda's premier technology and business incubation center in the field of food and nutrition. Housed at the School of Food Technology, Nutrition and Bioengineering, Makerere University, the center provides a place, opportunity and an enabling environment where innovations, knowledge and skills are transformed into viable enterprises. MAK-FTBIC targets to serve students, fresh graduates, youths and women with innovative food science and technology ideas that have commercial potential.

MAK-FTBIC offers services including but not limited to: Access to food processing equipment for production, development and piloting; Quality and safety testing facilities; Technical support in research as well as product development and formulation; Production scale up and pilot testing; Production, quality and safety management systems development and support; Enterprise and business systems development; Business concept and model generation; Intellectual property evaluation and management support; Short training courses in food processing and preservation; Technical support to SMEs; and Design and fabrication of agro-processing equipment.

MUARIK gets new Farm Manager

The Acting Farm Manager, Makerere University Agricultural Research Institute (MUARIK), Dr. Stephen Lwasa handed over office to the incoming Farm Manager, Mr. Natamba Leo on 17th November 2021. The handover took place at the Graduate and Research Labs at MUARIK and was witnessed by the Management team of MUARIK including; Dr. Okello Ongom (Director, MUARIK), Mr. Mutungire Boaz (Head, Crop Section), Mr. Aziz Dara Charles (Head, Machinery Unit), Mr. Taremwa Precious (Head, Livestock Section), Mr. Owori Julius (Head, Security Unit), Mr. Lugard Muguruka (Accounts Assistant), and Ms. Mercy Awalo (Training Coordinator). Dr Lwasa thanked the Vice Chancellor, Makerere University, Prof. Barnabas Nawangwe, and the Principal, College of Agricultural and Environmental Sciences (CAES), Prof. Bernard Bashaasha for appointing him to serve the University in that capacity. He thanked the Director, MUARIK, Dr Syrus Ongom Okello and his entire management team for the cooperation and support extended to him as he strived to organize and streamline the operations of MUARIK.

Association of Uganda Professional Agriculturalists (ASUPA) Gets a New President

ASUPA was founded on 29th November 2001 by professional agriculturalists and other stakeholders following the lack of an impartial and comprehensive national facilitator of professional dialogue on critical agricultural policy issues. The association is mandated to preserve ethical values and integrity of agriculture as a profession and enhance the commitment of agricultural professionals in developing and advocating policies and strategies for agricultural and rural development. On 29th October 2021, out-going President, Prof. E.N. Sabiiti handed over to the incoming President, Dr Donald Kugonza at a ceremony witnessed by the Principal, College of Agricultural and Environmental Sciences (CAES), Prof. Bernard Bashaasha. Delivering his remarks, Prof. Bashaasha applauded Prof. Donald Kugonza for accepting to take on the leadership of ASUPA despite his representation of the College on the Fisheries Council as well as many other associations. "Many people don't want to serve yet the bible is very clear on this - we were created to love and serve each other," he said. In his remarks, Prof. Sabiiti pointed out that ASUPA is constitutionally recognized and strongly supported by several agricultural organizations including NARO and NAADS. According to Prof. E.N. Sabiiti, an idea always starts but it takes time to get roots. "Our idea 'ASUPA' has developed some roots, and only requires nurturing," he said.

Table 20: Appointments, Promotions And Confirmations

PROMOTIONS			
NO.	NAME	DEPARTMENT	RANK
1.	Dr Issa Kabenge	Agricultural and Biosystems Engineering	Associate Professor
2.	Dr John Baptist Tumuhairwe	Agricultural Production	Associate Professor
3.	Dr Agnes Nabubuya	Food Technology and Nutrition	Senior Lecturer
4.	Dr Gaston Ampek Tumuhimbise	Food Technology and Nutrition	Senior Lecturer
5.	Dr Julia Bulya Kigozi	Agricultural and Biosystems Engineering	Senior Lecturer
6.	Dr Peter Wasswa	Agricultural Production	Senior Lecturer
7.	Dr Thomas Lapaka Odong	Agricultural Production	Senior Lecturer
8.	Dr Florence Lwiza Nsereko	Agribusiness and Natural Resource Economics	Lecturer
9.	Dr Anthony Mwije	Agricultural Production	Lecturer
10.	Dr Amos Ochieng	Forestry, Biodiversity and Tourism	Lecturer
11.	Dr Boniface Emuria Orum	Extension and Innovation Studies	Lecturer
CONFIRMATIONS			
1.	Dr John Ilukor	Agribusiness and Natural Resource Economics	Lecturer
2.	Mr. Michael Bruce Byaruhanga	Forestry, Biodiversity and Tourism	Assistant Lecturer
NO	**NAME**	**DEPARTMENT/UNIT**	**RANK/DESIGNATION**
1.	Mr. Leo Natamba	Makerere Agricultural Research Institute (MUARIK)	Farm Manager
2.	Dr Isaac Newton Alou	Agricultural Production	Lecturer
3.	Dr Moses Okech	Extension and Innovation Studies	Lecturer
4.	Dr. Paul Aseete	Agribusiness and Natural Resource Economics	Assistant Lecturer
5.	Ms. Catherine Mulinde	Geography, Geoinformatics and Climatic Science	Assistant Lecturer
6.	Ms. Slyvia Nyamaizi	Agricultural Production	Assistant Lecturer
7.	Ms. Zainah Nampijja	Agricultural Production	Assistant Lecturer
8.	Mr. Pius Lutakome	Agricultural Production	Assistant Lecturer
9.	Mr. Erion Bwambale	Agricultural and Biosystems Engineering	Assistant Lecturer
10.	Dr. Stellah Byakika	Food Technology and Nutrition	Assistant Lecturer
POST RETIREMENT CONTRACT			
1.	Dr Fredrick Tumwine	Geography, Geoinformatics and Climatic Sciences	Associate Professor
RESIGNATION			
1.	Mr. Francis Kimbowa	Forestry, Biodiversity and Tourism	Assistant Lecturer

Table 21: Staff Establishment

	College / Admininistrative Unit		Name Of College Principal Or Head Or Administrative Unit
	College Of Agricultural And Environmental Sciences		PROF. BERNARD BASHAASHA
S/N	Name Of Staff	Position	Gender
	ADMINISTRATIVE STAFF		
1	Jofrina Kyohairwe	College Registrar	F
2	Tom Vok Elwana	Accountant/ Team Leader	M
3	Annet Naluyinda	Accountant	F
4	George William Opee	Accountant	M
5	Harriet Hawa Juma	Principal Human Resource Officer	F
6	Mary Nantale	Administrative Secretary 1	F
7	Christine Apolot Oditte	Senior Administrative Assistant	F
8	Grace Apili	Senior Administrative Assistant	F
9	Dan Kiganda	Assistant Registrar	M
10	Kabejja Hasifa	Principal Communications Officer	F
11	Kasemiire Mariam	Wed Administrator	F
	SUPPORT STAFF		
12	Hamba Loyce	Secretary	F
13	Anyaku Isaac	Custodian	M
14	Peter Walusimbi	Driver	M
15	Ntambi Jimmy	Driver	M
16	Magal Joseph	Security Guard	M
17	Kibirango Charles	Security Guard	M
18	Kidyani Paul	Security Guard	M
19	Kabanda Margaret	Library Assistant	F
20	Gorreti Aguttu	Principal Technician	F
21	Maria Nalukwago	Cleaner	F
22	Jonnes Sserugendo	Cleaner	M
23	Immaculate Nakafeero	Pool Stenographer	F
24	Dorothy Nabakabya	Senior Technician	F
25	Ambrose Atwine	Technician	M
26	Jessica Kaahwa	Copy Typist	F
27	Ponsiano Sendegeya	Lab Attendant	M
28	Kaitsei Benny	Sanitary Cleaner	M
29	Nasanga Juliet	Cleaner	F
30	Namubiru Justine	Cleaner	F
31	Namudu Sarah	Cleaner	F
32	Naggayi Teddy	Messenger/Cleaner	F
33	Ndagire Aidah	Sanitary Cleaner	F

34	Were Charles	Sanitary Cleaner	M
35	Nanozi Catherine	Sanitary Cleaner	F
36	Kisitu Daniel	Computer Techinician	M
37	Nanteza Florence	Library Assistant	F
38	Tumwesigye Phoebe	Administrative Assistant II	F
39	Namirembe Goretti	Sanitary Cleaner	F
40	Nanziri Sarah	Administrative Secretary III	F
41	Nalwanga Shiffah	Messenger	F
42	Namazzi Mayanja Gorretti	Head Cleaner	F
43	Namukwaya Margaret	Cleaner	F
45	Kiggundu Habibu	Cleaner	M
46	Birungi Rose	Cleaner	F
47	Mwiyeretsi James	Sanitary Cleaner	M
48	Nassanga Costance	Sanitary Cleaner	F
49	Musaazi Matthias	Security Guard	M
50	Kato Tom	Driver	M
51	Buzimwa Muhammadi	Turn Boy	M
52	Wairagala Bonny	Turn Boy	M
53	Alelo Christine	Security Guard	F
54	Mutebi Emmanuel	Senior Technician	M
55	Mzee Patrick	Laboratory Assistant	M
56	Najjuma Christine	Technical Assistant	F
57	Nagaddya Harriet	Lab. Attendant	F
58	Kawooya Teddy Mary	Lab. Attendant	F
59	Nabimanya Deborah	Cleaner/Messenger	F
60	Kyobutungi Edith	Cleaner/Messenger	F
61	Kabonesa Grace	Cleaner	F
62	Bukenya Joseph	Labourer	M
63	Nanozi Margaret	Cleaner/Messenger	F
64	Muhereza Richard	General Farm Worker	M
65	Onyera Mary	Gardener	F
66	Nantale Agnes	General Farm Worker	F
67	Nakaana Peninah	Copy Typist	F
68	Andrew Otim	Technician	M
69	James Kaddu Makubuya	Technician II	M
70	John Tumwijukye	Ox-Man	M
71	Mr. Ronald Nsobya	Ox-Man	M
72	Nakalema Imelda	Messenger/Cleaner	F
73	Nanyonga Annet	Senior Copy Typist	F
74	Nambatya Ruth	Copy Typist	F
75	Kasujja Geoffrey	Lab. Assistant	M
76	Ndagire Deborah	Cleaner/Messenger	F

77	Naggayi Teddy	Messenger/Cleaner	F
78	Ndagire Aidah	Sanitary Cleaner	F
79	Nankunda Bennet	Custodian	F
80	Nakiyemba Consolata	Administrative Secretary II	F
81	Namukwaya Ruth	Lab. Attendant	F
82	Ssentomero Dan	Technician I	M
83	Kusemererwa Aggrey	Driver	M
84	Sombi Kella	Cleaner	M
85	Nagawa Maimuna	Sanitary Cleaner	F
86	Musoke Harriet	Cleaner	F
87	Namukwaya Margaret	Cleaner	F
88	Natamba Leo	Farm Manager	M
89	Mr. Banjwa H. Samuel	Asst. Foreman	M
90	Kiwanuka Robert	Tractor Driver	M
91	Okello Richard	Carpenter	M
92	Musoma Moses	Driver	M
93	Musisi Vincent	Sanitary Cleaner	M
94	Ntongo Edith	Sanitary Cleaner	F
96	Mutungire Bowers	General Farm Worker	M
97	Toko George	General Farm Worker	M
98	Kaaja Yusuf	General Farm Worker	M
99	Nabwire Immaculate	General Farm Worker	F
100	Male Stuart	General Farm Worker	M
101	Nambaziira Harriet	General Farm Worker	F
102	Musisi Godfrey	General Farm Worker	M
103	Nambooze Joyce	General Farm Worker	F
104	Ssentamu Godfrey	General Farm Worker	M
105	Nabisubi Kasifa	General Farm Worker	F
106	Nuwagaba Abias	General Farm Worker	M
107	Ndezaho Godfrey	General Farm Worker	M
108	Nandawula Margret	General Farm Worker	F
109	Nanfuka Harriet	General Farm Worker	F
110	Zaguma Godfrey	General Farm Worker	M
111	Balyejusa Samuel	General Farm Worker	M
112	Tumukunde Herbert	Clerical Officer - Accounts	M
113	Berunga Winfred	Clerk Of Works	F
114	Tumushabe Jannet	Library Assistant	F
115	Byaruhanga Andrew Simon	Security Guard	M
116	Tumusiime Yosinta	Office Messenger	M
117	Sabiiti Charles	Trail Cutter	M
	Department of Agricultural Production		
118	Kyamanywa Samuel	Professor	M
119	Tukamuhabwa Phinehas	Professor	M

120	Basamba Ali Twaha Ateenyi	Associate Professor	M
121	Karungi Jeninah	Associate Professor	F
122	Talwana Herbert	Associate Professor	M
123	Kabi Fred	Associate Professor	M
124	Mukasa Settumba Blasio	Associate Professor	M
125	Kugonza Donald Rugira	Associate Professor	M
126	Mpairwe Denis R	Associate Professor	M
127	Tumuhairwe John Baptist	Associate Professor	M
128	Nambi-Kasozi Justine	Senior Lecturer	F
129	Tusiime Geofrey	Senior Lecturer	M
130	Edema Richard	Senior Lecturer	M
131	Ebanyat Peter	Senior Lecturer	M
132	Katongole Constantine Bakyusa	Senior Lecturer	M
133	Bisikwa Jenipher	Senior Lecturer	F
134	Ochwo Ssemakula M K N	Senior Lecturer	F
135	Katuromunda Sylvester	Senior Lecturer	M
136	Odong Thomas Lapaka	Senior Lecturer	M
137	Wasswa Peter	Senior Lecturer	M
138	Tibayungwa Francis	Lecturer	M
139	Olupot Giregon	Lecturer	M
140	Walusimbi Sadhat	Lecturer	M
141	Zziwa Emmanuel	Lecturer	M
142	Ongom O Robert Cyrus	Lecturer	M
143	Opolot Emmanuel	Lecturer	M
144	Taulya Godfrey	Lecturer	M
145	Musinguzi Patrick	Lecturer	M
146	Nuwamanya Epraim	Lecturer	M
147	Alou Isaac Newton	Lecturer	M
148	Mwije Anthony	Lecturer	M
149	Tibezinda Mary	Assistant Lecturer	F
150	Kamatara Kanifa	Assistant Lecturer	F
151	Magala Henry	Assistant Lecturer	M
152	Idibu Joachine	Assistant Lecturer	M
153	Simon John Bright Habinshuti	Assistant Lecturer	M
154	Obua Tonny	Assistant Lecturer	M
155	Lutakome Pius	Assistant Lecturer	M
156	Nampijja Zainah	Assistant Lecturer	F
157	Nyamaizi Sylivia	Assistant Lecturer	F
158	Kyeyune Gerald	Chief Technician	M
159	Kiirya David	Chief Technician	M
160	Serunjoji Katende Steven	Principal Technician	M
161	Natumanya Robert	Principal Technician	M
162	Kakooza Lydia	Principal Technician	F

Department Of Agribusiness And Natural Resource Economics			
163	Gabriel Elepu	Senior Lecturer/Head	M
164	Bernard Bashaasha	Professor/Principal	M
165	Johnny Mugisha	Professor	M
166	Dick Sserunkuuma	Professor	M
167	Mukadasi Buyinza	Professor /Director, DRGT	M
168	Theodora.S. Hyuha	Assoc. Professor	M
169	Fredrick Bagamba	Senior Lecturer	M
170	Jackline Bonabana-Wabbi	Associate Professor	F
171	Gracious. Diiro	Senior Lecturer	M
172	Rosemary Isoto	Lecturer	F
173	Stephen Lwasa	Lecturer	M
174	Ilukor John	Lecturer	M
175	Alice Turinawe	Lecturer	F
176	Alex Tatwangire	Lecturer	M
177	Florence Lwiza Nsereko	Lecturer	F
178	George Omiat	Assistant Lecturer	M
179	Paul Aseete	Assistant Lecturer	M
180	Elizabeth. Ahikiriza	Assistant Lecturer	F
Department of Extension and Innovation Studies			
181	Turyahabwe Nelson	Professor	M
182	Agea Jacob Godfrey	Professor	M
183	Najjingo Mangheni M K	Associate Professor	F
184	Kibwika Paul	Associate Professor	M
185	Nabanoga Gorretie	Associate Professor	F
186	Miiro Richard	Senior Lecturer	M
187	Isubikalu Prossy	Senior Lecturer	F
188	Kyazze Florence Birungi	Senior Lecturer	F
189	Obaa Bernard Bonton	Senior Lecturer	M
190	Karuhanga Monica	Lecturer	F
191	Karubanga Gabriel	Lecturer	M
192	Mubangizi Narisi	Lecturer	M
193	Nasirumbi Losira	Lecturer	F
194	Akello Sarah	Lecturer	F
195	Orum Emuria Boniface	Lecturer	M
196	Okech Moses	Lecturer	M
197	Mulugo Lucy	Assistant Lecturer	F
198	Mawa Christopher	Assistant Lecturer	M
200	Biryomumaisho Dickson	Assistant Lecturer	M
201	Mukebezi Rebecca	Assistant Lecturer	F

Department of Agricultural and BioSystems Engineering			
202	Isa Kabenge	Associate Professor	M
203	Ahamada Zziwa	Associate Professor	M
204	Wanyama Joshua	Senior Lecturer	M
205	Allan John Komakech	Senior Lecturer	M
206	Nicholas Kiggundu	Senior Lecturer	M
207	Julia Kigozi	Senior Lecturer	F
208	John Bosco Kawongolo	Senior Lecturer	M
209	Kivumbi Hussein Balimunsi	Senior Lecturer	M
210	Peter Tumutegyereize	Lecturer	M
211	Robert Kyeyune Kambugu	Lecturer	M
212	Peter Mulamba	Lecturer	M
213	Sam Cherotich	Assistant Lecturer	M
214	Prossie Nakawuka	Assistant Lecturer	F
215	Ayaa Fildah	Assistant Lecturer	F
216	Francis Okori	Assistant Lecturer	M
217	Erion Bwambale	Assistant Lecturer	M
Department of Food Technology and Nutrition			
218	John Muyonga	Professor	M
219	Archileo Kaaya	Professor	M
220	Charles Muyanja	Professor	M
221	Yusuf Byenkya Byaruhanga	Assoc. Professor	M
222	Dorothy Nakimbugwe	Assoc. Professor	F
223	Ivan Muzira Mukisa	Assoc. Professor	M
224	Abel Atukwase	Senior Lecturer	M
225	Margaret Kabahenda	Senior Lecturer	F
226	Gaston Ampe Tumuhimbise	Senior Lecturer	M
227	Agnes Nabubuya	Senior Lecturer	F
228	Acham Hedwig	Senior Lecturer	M
229	Denis Male	Lecturer	M
230	Robert Fungo	Lecturer	M
231	Robert Mugabi	Lecturer	M
232	Florence Mary Turyashemererwa	Lecturer	F
233	Fred Brany Lukwago	Assistant Lecturer	M
234	Stellah Byakika	Assistant Lecturer	F
235	Joseph Balamaze	Chief Technician	M
236	Emmanuel Okalany	Principal Technician	M
Department of Environmental Management			
237	Frank Kansiime	Professor	M
238	John R.S Tabuti	Professor	M
239	David Tumusiime	Professor	M
240	Vincent Muwanika	Assoc. Professor	M

241	Justine Namaalwa	Senior Lecturer	F
242	Bob Nakileza	Senior Lecturer	M
243	Anthony Egeru	Senior Lecturer	M
244	Kenneth Nyombi	Senior Lecturer	M
245	Patrick Byakagaba	Lecturer	M
246	Ellen Kayendeke	Lecturer	F
247	Kinobe Joel	Lecturer	M
248	Kenneth Balikoowa	Assistant Lecturer	M
249	Erima Godwin	Assistant Lecturer	M
250	Ezra Natumanya	Assistant Lecturer	M
251	Fred Yikii	Assistant Lecturer	M
252	Faridah Nalwanga	Assistant Lecturer	F
253	Paul Musali	Assistant Lecturer	M
	Deoartment of Geography, Geo-Informatic and Climatic Sciences		
254	Tumwine Fredrick	Associate Professor	M
255	Bamutaze Yazidhi	Associate Professor	M
256	Mugagga Frank	Associate Professor	M
257	Twinomuhangi Revocatus	Senior Lecturer	M
258	Waiswa Daniel	Senior Lecturer	M
259	Isolo Mukwaya Paul	Senior Lecturer	M
260	Mfitumukiza David	Senior Lecturer	M
261	Nimusiima Alex	Lecturer	M
262	Nanteza Jamiat	Lecturer	F
263	Twinorugyendo Penninah	Lecturer	F
264	Sabiiti Geoffrey	Lecturer	M
265	Musoke Semakula Henry	Lecturer	M
266	Ddumba Saul Daniel	Lecturer	M
267	Wasswa Hannington	Lecturer	M
268	Mugume Isaac	Lecturer	M
269	Nseka Denis	Lecturer	M
270	Aboda Caroline	Lecturer	F
271	Mulinde Catherine	Assistant Lecturer	F
	Department of Forestry, Biodiversity And Tourism		
272	Nyakaana Jockey Baker	Professor	M
273	Banana Abwoli Yabezi	Professor	M
274	Tweheyo Mnason	Professor	M
275	Nyeko Philip	Professor	M
276	Obua Joseph	Professor	M
277	Eilu Gerald	Associate Professor	M
278	Okullo John Bosco	Associate Professor	M
279	Babweteera Fred	Associate Professor	M
280	Ahebwa W Manyisa	Associate Professor	M

281	Mwavu Nector Edward	Associate Professor	M
282	Balaba Susan Tumwebaze	Associate Professor	F
283	Bahati Joseph Basikhan	Senior Lecturer	M
284	Mugabi Paul	Senior Lecturer	M
285	Nakabonge Grace	Senior Lecturer	F
286	Orikiriza Baguma Lawrence Justus	Senior Lecturer	M
287	Ayorekire Jim	Senior Lecturer	M
288	Mbogga Michael Ssekaayi	Lecturer	M
289	Nagawa Christine Betty	Lecturer	F
290	Muhwezi Deus Kamunyu	Lecturer	M
291	Rutabatiina Abraham Mwesigye	Lecturer	M
292	Mugizi Francis	Lecturer	M
293	Kizito Simon	Lecturer	M
294	Boonabana Brenda	Lecturer	M
295	Ssekuubwa Enock	Lecturer	M
296	Ochieng Amos	Lecturer	M
297	Byaruhanga Micheal	Assistant Lecturer	M
298	Sseremba Owen Emmanuel	Assistant Lecturer	M
299	Syofuna Agatha	Assistant Lecturer	M
300	Nsobya Joseph	Librarian	M
301	Mulwanyi Edward	Security Personnel	M

Table 22: CAES CONTRACT STAFF

CONTRACT STAFF PAID BY THE COLLEGE AS OF FEBRUARY 2022

No.	POSITION	NAME	GENDER	UNIT
1	Assistant Accountant	Namusoke Terry	F	Principal's Office
2	Assistant Accountant	Mbabazi Grace	F	Principal's Office
3	Systems Admin	Muhumuza Albert	M	Principal's Office
4	Records Clerk	Acheko Dinah	F	Principal's Office
5	Custodian	Muhairwe Jude	M	Principal's Office
6	Watchman	Kayima Humalu	M	Principal's Office
7	Custodian	Francis Musana	M	DEM
8	Custodian - MUARIK	Benjamin Ashok Ogutti	M	Principal's Office
9	Office Attendant	Namirembe Rose	F	Principal's Office
10	Office Attendant	Kisembo Wilson	M	Principal's Office
11	Driver	Mukonzi Eric	M	Principal's Office
12	Driver	David Kajozi Mubiru	M	Principal's Office
13	Driver	Mabonga Wilson	M	Principal's Office
14	Watchman	Owundo Dominic	M	Principal's Office
15	Administrative Assistant (Rec)	Gorret Kamoga Namukwaya	F	Principal's Office

16	Securyt Guard	Collin Wandwali	M	Principal's Office
17	Assistant Registrar	Hilda Mukune	F	Dean's Office SAS
18	Records Assistant	Joan Businge	F	SFEGS
19	Securyt Guard	Darius Mbonyintwari	M	SFTNB
20	Accounts & Logistics	Muguruka Lugard	M	MUARIK
21	Coordinator Dvc	Taremwa Precious	M	MUARIK
22	Technician	Wamala Robert	M	SFTNB
23	Technician	Nkinzehiki Allan Moses	M	SFTNB
24	Computer Technician	Lutalo William	M	SFEGS
25	Assistant Domestic Bursar	Kato Innocent Mwesige	M	MUBFS
26	Headman	Kugonza Robert	M	MUBFS
27	Cook	Kakyo Malyamu	M	MUBFS
28	Security Guard	Kasaija Ebenezer	M	MUBFS
29	Security Guard	Mugisa Expedito	M	MUBFS
30	Station Driver	Kyalimpa Wilson	M	MUBFS
31	Station Driver	Sembatya Paul	M	MUBFS
32	Store Man	Kemigisa Patience	M	MUBFS
33	Trail Cutter/Cleaner	Rutenta Wilson	M	MUBFS
34	Trail Cutter/Cleaner	Bamukusa Francis	M	MUBFS
35	Trail Cutter/Cleaner	Tibeya Adolf	M	MUBFS
36	Trail Cutter/Cleaner	Katuramu Clovis	M	MUBFS
37	Trail Cutter/Cleaner	Birungi Charles	M	MUBFS
38	Trail Cutter/Cleaner	Kisembo Vicent	M	MUBFS
39	Trail Cutter/Cleaner	Kusemererwa Charles	M	MUBFS
40	Trail Cutter/Cleaner (Ngogo)	Nyakahuma Richard	M	MUBFS
41	Trail Cutter/Cleaner (Ngogo)	Zahura James	M	MUBFS
42	Trail Cutter/Cleaner (Ngogo)	Atuhaire Samuel	M	MUBFS
43	Security Guard	Edelu Francis	M	MUARIK
44	Security Guard	Magino Richard	M	MUARIK
45	Security Guard	Lejorugu Benson	M	MUARIK
46	Security Guard	Ajawo William	M	MUARIK
47	Security Guard	Angutoko Marlon	M	MUARIK
48	General Farm Worker	Musinguzi Julius	M	MUARIK
49	General Farm Worker	Ndenzyaho Dominic	M	MUARIK
50	General Farm Worker	Bagenyi Mark	M	MUARIK
51	General Farm Worker	Nanfuka Sarah	F	MUARIK
52	General Farm Worker	Nakigozi Annet	F	MUARIK
53	General Farm Worker	Bsreba John	M	MUARIK
54	General Farm Worker	Nalugoye Grace	F	MUARIK
55	General Farm Worker	Eimana Stell	F	MUARIK
56	General Farm Worker	Kalenzi Festo	M	MUARIK
57	General Farm Worker	Agaba Issa	M	MUARIK
58	General Farm Worker	Kariia Julius	M	MUARIK

59	General Farm Worker	Nabakooza Imelda Mary	F	MUARIK
60	General Farm Worker	Niwamanya Tobias	M	MUARIK
61	General Farm Worker	Ssemambo Joseph	M	MUARIK
62	General Farm Worker	Mugumya Edgar	M	MUARIK
63	General Farm Worker	Ariho Benon	M	MUARIK
64	General Farm Worker	Muwonge Joseph	M	MUARIK
65	General Farm Worker	Byaruhanga Richard	M	MUARIK
66	General Farm Worker	Namwanje Robinah	F	MUARIK
67	Herdsman	Muhereza Baram	M	MUARIK
68	Plumber	Nuwagira Saxson	M	MUARIK
69	Tractor Operator/Driver	Ssamanya Alex	M	MUARIK
70	Assistant Foreman-Machinery	Azizi Dara Charles	M	MUARIK
71	Assistant Foreman-Poultry	Mpanga Joshua Samuel	M	MUARIK
72	Training Coordinator	Awalo Mercy	F	MUARIK

ACHIEVEMENTS

i) Increased student enrolment with undergraduates estimated at 2758 and graduate students estimated at 164 as of today. This makes a total of 2922 students.

ii) Growth in graduation rate. The number of undergraduates graduating from the College has increased from 362 in January 2013 to 467 in 2021. Graduate students from 83 (5 PhDs) in 2013 to 122 (with 21 PhDs) in 2021.

iii) Visibility of the College has been greatly enhanced through various platforms including the website, social media, brochures, newsletters and annual reports.

iv) Accelerated Research output: The college registered a total of 331 publications in 2021 up from 164 in 2018. The College revamped the MUARIK Bulletin into Makerere University Journal of Agricultural & Environmental Sciences (MUJAES) – up and running – Volume II Issue 1 is being processed.

v) Teaching space and facilities enhanced: The College has approximately 900.08sq metres of teaching space on main campus alone, and well furnished Graduate Teaching Laboratory at MUARIK.

vi) Increased number of projects/partnerships: The College currently has a total of 96 projects totaling UGX 761,809,015+ 43,418, USD 1,389,641.68 + 16,323.21 + 127,047.46 and EURO 838,734.34.

vii) Increased Menu of programmes: Over time the number of programmes offered in the College have grown to 13 undergraduate programs and 24 graduate programmes. A total of 6 new programmes have been developed during the last 8 years. Another 6 programmes are in the pipeline.

viii) Research Grants Office established: A research grants office has been established at the College.

ix) Research, Ethics Committee (REC): The College has laid the foundation for CAES REC to support the ethical aspects of research. An interim REC Committee has been appointed and the application is with the National Council for Higher Education.

x) Growth in the number of centres/institutes: The number of centres in the College has increased.

xi) Rehabilitation of MUARIK: Basic infrastructure including fence & road infrastructure at MUARIK were rehabilitated. The Farm is now working at nearly full production capacity. New enterprises such as layers and an orchard have been added.

xii) Several high level research innovations developed: A hybrid dryer, automatic communal borehole, 3D thermal imaging for the pots (value added potatoes), refractive window drying technology for fruits.

CHALLENGES

i) Erosion of staff: overtime staff have retired, resigned or passed on without being replaced. This means majority of the units are currently understaffed both academically and administratively.

ii) Transport: The entire fleet of the College is aging. This means a huge budget for repairs.

iii) Data for staff to support Blended Teaching and Learning: The college has not been able to adequately support staff with data. For some time, this has been a big bottleneck for efficient delivery of lectures especially while off campus.

iv) Underfunding: The College approved budget has been reducing overtime from the initial UGX 2.5 billion to UGX 2.2 billion and now to UGX1.3 billion, yet college activities and funding needs have been increasing.

v) Lack of a Budget for MUARIK: MUARIK is a core training facility at the heart of CAES yet the institution receives no budget allocation from the centre. The need to support core activities at MUARIK further constrains the college budget. At the same time, lack of funding means that some important MUARIK core activities cannot be implemented.

vi) Overstay on the programme: It is very difficult to put a correct figure on the number of graduate students in the college because many would be "graduate students" have never fully registered although they attend classes. Furthermore, many overstay their programme duration on account of various reasons related to student and supervisors.

vii) Teaching space: The increasing number of programmes and students in the continues to constrain College teaching and research facilities.

viii) Computer facilities for undergraduate students: All computer labs in the College have obsolete computers unable to support student learning especially in this era of blended teaching and learning.

GONE BUT NOT FORGOTTEN

Celebrating the Life and Trailblazing Career of Fallen Prof. Noble Banadda

Born on 14th May 1975, Prof. Noble Banadda succumbed to COVID-19 on 1st July 2021.

Prof. Banadda was the first Sub-Saharan African to graduate with a PhD in Chemical Engineering from the Katholiek University Leuven in Belgium opening many doors for Africans. He was appointed Lecturer of Makerere University on 1st July 2011 and was one of the beneficiaries of the fast tract promotion system and was promoted to the rank of full professor on 1st August, 2012 and later confirmed on 1st January 2012. In 2013 Prof. Banadda was appointed Head Department of Agricultural and Bio-systems Engineering, served for four years and re-elected effective 1st September 2017 to 31st August 2021. Under his leadership, the Department of Agricultural and Biosystems Engineering was a leader in providing engineering solutions to agricultural problems in Uganda and Africa. Prof. Banadda had a trailblazing scientific career.

Prof. Banada was the first African recipient of the Pius XI Golden Medal 2018 in the Vatican Rome – the first African under the age of 45 to be recognized by a sitting pope. He was a Laureate of the Next Einstein Fellowship; Alumni of the Global Young Academy; Member of the Malabo Panel of Experts; Fellow of the Uganda National Academy of Sciences; Council member of the Pan African Society for Agricultural Engineering; Member of the Makerere University Senate; Adjunct Professor at Iowa State University (USA); Research Fellow at Clare Hall at University of Cambridge (UK); and college member of the UKRI GCRF programme. In October 2020, Prof. Banadda was inaugurated Oliver Reginald Tambo Research Chair honored young scientist at the World Economic Forum attracting USD 250, 000 annually and an additional £ 100,000 Euros for the next 15 years for graduate research in Agricultural waste management with a target of training 15 PhDs, 9 Post-doctorals and 27 MSc. His research focus areas were in the bio-systems engineering field and included mathematical modeling of biological systems and interactions. His goal was to create value-added products from solid biowaste resources.

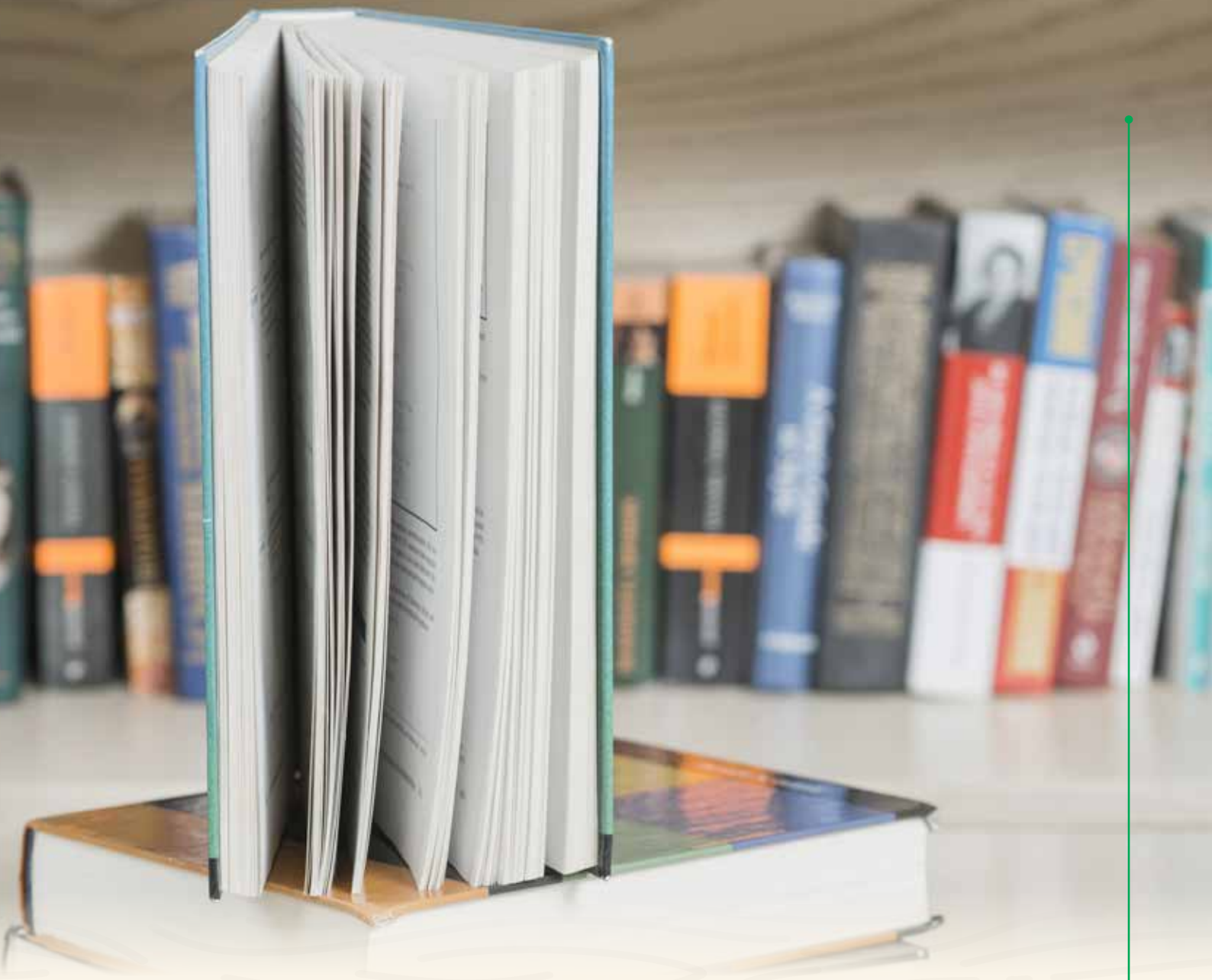
Prof. Banadda raised the flag of Makerere University at both local and international scene. Every year Prof. Banadda had a technology or an innovation to launch. He was the brain behind the development of the parts of the Bulamu Ventilator and the Biodegradable face shields in the efforts to combat COVID -19. He developed the solar powered irrigation pump, the Multipurpose Farmers' Tractor called MV Mulimi, and started the extraction of fuel from hard plastics and making insecticides from the eucalyptus and other agricultural waste among others. Prof. Banadda was favourably cited with thus far published research findings in over 240 peer-reviewed journal Scientific publications, with a record of 76,086 Reads and 1,201 Citations. He also (co)-supervised 12 PhD students to Completion and 31 M.Sc. students. At the time of his death, a number of PhD and Master students were under his supervision. Prof. Banadda served in the following capacities: Member of Makerere University Council, Member of Makerere University Senate, Chairperson of Makerere University Contracts Committee.

Prof. Banadda made an indelible mark with his youthful and dynamic leadership as head of department and his sharp intellect and dedication to his students will not be soon forgotten.

May His Soul Continue Resting in Peace.

Table 23: CAES Accounts and Bank Balances as at January 31st 2022

ACCOUNT NAME	BANK NAME	ACCOUNT NUMBER	CURRENCY	BALANCE AS AT JANUARY 31ST 2022
College of Agric & Environmental Sciences	ABSA	0341424240	UGX	761,809,015 (See Annex 5)
College of Agric & Environmental Sciences	ABSA	0344241694	USD	1,389,641.68 (See Annex 6)
College of Agric & Environmental Sciences	ABSA	6003566658	EURO	838,734.34 (See Annex 7)
Makerere University Nutrition Innovation Laboratory	DFCU	02083502219046	USD	16,323.21 (See Annex 8)
Makerere University Regional Centre For Crop Improvement	BOU	003360088400006	USD	127,047.46 (see Annex 9)
Makerere University Regional Centre For Crop Improvement	BOU	003360088000005	UGX	43,418 (see Annex 10)



2021 ANNUAL REPORT - CAES PUBLICATIONS

School of Agricultural Sciences

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2. Amann, A., Herrnegger, M., Karungi, J., Komakech, A.J., Mwanake, H., Schneider, L., Schürz, C., Stecher, G., Turinawe, A., Zessner, M., Lederer, J. 2021. Can local nutrient-circularity and erosion control increase yields of resource-constraint smallholder farmers? A case study in Kenya and Uganda, Journal of Cleaner Production 318 (2021) 128510. https://doi.org/10.1016/j.jclepro.2021.128510.

3. Katono K, Macfadyen S, Omongo AC, Odong TL, Colvin J, Karungi J and Otim MH. 2021. Influence of cassava morphological traits and environmental conditions on field populations of Bemisia tabaci, Insects 2021, 12, 604. https://doi.org/10.3390/insects12070604

4. Katono K, Macfadyen S, Omongo AC, Odong TL, Colvin J, Karungi J and Otim MH. 2021. Mortality factors acting on field populations of Bemisia tabaci (Hemiptera: Aleyrodidae) SSA1 on cassava in Uganda, Eur. J. Entomol. 118: 148-158. https://doi.org/10.14411/eje.2021.016

5. Ijala, A.R., Kyamanywa, S., Cherukut, S., Sebatta, C., Kyamanywa, S. and Karungi, J. 2021. Can Occurrence and Distribution of Ground Beetles (Carabidae) Be Influenced by the Coffee Farming System in the Mount Elgon Region of Uganda? Neotrop. Entomol. https://doi.org/10.1007/s13744-021-00872-4

6. Ssekkadde, P., Ribeiro, C.S.C., Ochwo-Ssemakula, M.N., Tukamuhabwa, P. and Karungi, J. 2021. Fruit traits associated with resistance to fruit pests of hot pepper, Makerere University Journal of Agricultural and Environmental Sciences Vol. 10 (1). pp. 22 – 46.

7. Ijala, A.R., Kyamanywa, S., Cherukut, C., Sebatta, C., Hilger, T. and Karungi, J. 2021. Host- plant and insect- pest compensations, and microclimate as drivers for intensity of Toxoptera aurantii (Hemiptera: Aphididae) in Arabica coffee-banana farming system of Mount Elgon region, Uganda, African Crop Science Journal Vol. 29(2). https://dx.doi.org/10.4314/acsj.v29i2.4

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9. Ssendikadiwa, J.K., Bisikwa, J. and Ssebuliba, J.M. (2021). Yield performance and stability of elite groundnut varieties in multi-location experiments in central Uganda - A short communication Makerere University Journal of Agricultural and Environmental Sciences Vol. 10 (2). pp. 163 - 177, 2021 Printed in Uganda. All rights reserved © Makerere University 2021 ISSN 1563-3721

10. Bisikwa J., Roger L. Becker, Vince A. Fritz, Kevin Natukunda and Martha I. Natukunda (2021). Response of giant foxtail and wild proso millet to artificial light quality alteration. Journal of Scientific Agriculture 2021, 5: 26-31 doi: 10.25081/jsa.2021.v5.6898. http://updatepublishing.com/journal/index.php/jsa. ISSN: 2184-0261

11. Bisikwa J., Roger L. Becker, Vince A. Fritz, Kevin Natukunda and Martha I. Natukunda (2021). Effect of crop canopy manipulation on light interception, growth, and development of wild proso millet and giant foxtail in row-cropping systems. African Journal of Agricultural Research, Vol. 17(1), pp. 147-155, January, 2021 DOI: 10.5897/AJAR2020.15223 Article Number: 1DC3E0165851 ISSN: 1991-637X Copyright ©2021 Author(s) retain the copyright of this article http://www.academicjournals.org/AJAR

12. Bisikwa, J., Walukano, W., Ugen, M.A., Muyinda, A.M. and Muyonga, J.H. (2020). Effect of variety and soil fertility management on performance of grain amaranth in different agro-ecological zones in Uganda. Makerere University Journal of Agricultural and Environmental Sciences, Vol. 9 (1). pp. 39 - 57, 2020. Printed in Uganda. All rights reserved © Makerere University 2020. ISSN 1563-3721

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14. Joseph Ekwangu, John Steven Tenywa, Jenipher Bisikwa, Charles Andiku, Paul Anguria, Monday Moses Paga, Deborah Lillian Nabirye, Michael Adrogu Ugen & Nelson Wanyera (2020). Effect of Inorganic Fertilizer Micro-dosing and Weed Management Regimes on Finger Millet Productivity in Uganda. Journal of Agricultural Science; Vol. 12, No. 12; 2020 ISSN 1916-9752 E-ISSN 1916-9760 Published by Canadian Center of Science and Education

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17. Vivian Namutebi, Lukman Nagaya Mulumba and Jenipher Bisikwa (2020). Evaluation of Cereal-Legume Cropping on Striga Control and Maize Yield. Journal of Agricultural Science and Technology B 10 (2020) 43-48 doi: 10.17265/2161-6264/2020.01.005. DAVID PUBLISHING

18. Martha Ibore Natukunda, Kevin Natukunda, Gerald Kyeyune, Sharon Mbabazi Tusiime, Isaac Agbemafle and Jenipher Bisikwa (2020). Management strategies for the noxious invasive parthenium weed (Parthenium hysterophorus L.) in Uganda. African Journal of Agricultural Research, Vol. 15(1), pp. 1-9, January, 2020 DOI: 10.5897/AJAR2019.14569 http://www.academicjournals.org/AJAR

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