CAPACITY BUILDING IN AGRICULTURAL RESEARCH

A Case Study on Uganda's Makerere University

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AGRICULTURAL R&D: INVESTING IN AFRICA'S FUTURE
Analyzing Trends, Challenges, and Opportunities

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Acronyms and Abbreviations

AgGDP	Agricultural gross domestic product
AGRA	Alliance for a Green Revolution in Africa
ASARECA	Association for Strengthening Agricultural Research in East and Central Africa
AAU	Association of African Universities
AU	African Union
CAADP	Comprehensive Africa Agriculture Development Programme
CAES	College of Agricultural and Environmental Sciences
CGIAR	Consultative Group on International Agricultural Research
CIDA	Canadian International Development Agency
DAAD	German Academic Exchange Service
DFID	Department for International Development
DSIP	Development Strategy and Investment Plan
EAC	East African Community
FARA	Forum for Agricultural Research in Africa
GDP	gross domestic product
JICA	Japan International Cooperation Agency
MAAIF	Ministry of Agriculture Animal Husbandry and Fisheries
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organisation
NARS(s)	National Agricultural Research System(s)
NEPAD	The New partnership for Africa's development
NORAD	Norwegian Agency for Development Cooperation
ODA	overseas development assistance
PEAP	Poverty Eradication Action Plan
PMA	Plan for the Modernization of Agriculture
R&D	research and development
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
S&T	science and technology
Sida	Swedish International Development and Cooperation Agency
SRO(s)	subregional organization(s)
UMA	Uganda Manufacturers' Association
USAID	United States Agency for International Development

Abstract

The African Union has developed a strategic framework to support African socioeconomic development being implemented by the New partnership for Africa's development (NEPAD). The strategic framework seeks to radically increase and sustain Africa's agricultural sector to ensure food security and economic development. In addition to CAADP, the Government of Uganda has developed the Government Prosperity for All policy, and the National Development Plan guide policy within the agricultural sector. To support this broad development strategy, Makerere University has been required to learn as it engages in agricultural research and development (R&D) and develops much-needed human resource capacity. The University's key contributions to regional agricultural R&D development include (1) policy research and information, (2) strategic R&D, (3) support for agricultural extension services, (4) support for research innovation, (5) a focus on emergent development challenges, (6) training for regional agricultural R&D needs, (7) meeting national agricultural R&D capacity needs, and (8) support for national agricultural development. These activities are mainly being implemented in the College of Agricultural and Environmental Sciences (CAES) and the School of Veterinary Medicine, funded by the Government of Uganda and its development partners. Public–private partnerships remain weak.

1. INTRODUCTION

Uganda is a member of the East African Community (EAC). More than half the country's land area of approximately 242,000 square kilometers is directly used for agriculture—31 percent for arable agriculture and 20 percent for livestock production—and of a population of about 32 million, 85 percent reside in rural areas and are employed in the agricultural sector. Between 1965 and 1980, the country's agricultural gross domestic product (AgGDP) grew at about 1.2 percent, and the sector accounted for up to 70 percent of GDP. During the civil war period of 1980–85, AgGDP grew by 2.3 percent, and post–civil war, from 1987 to 1996, AgGDP grew at 5.1 percent and GDP by 6.5 percent (Baffoe 2000). The national poverty headcount fell from 60 percent in 1992 to 24.5 percent in 2010 as a result of positive changes in the agricultural sector (UBOS 2010). Although AgGDP's overall contribution to the economy contracted from 70 percent in the 1970s to less than 20 percent in 2010 due to growth in the services and industry subsectors of the economy, the sector is still crucial to economic growth. Agricultural growth is needed to buffer the country's vulnerability to climate change, feed a population that is expected to double by 2050, and support a growing industrial sector (GOU 2010b).

Reinvigorating growth of Uganda's AgGDP, which stood at 2.1 percent as of 2010 (GOU 2010a), requires the empowerment of farmers, the adoption of technology, and growth in both yield and farmer incomes through value addition and access to technology, advisory services, and markets, among other factors. Growth also requires strengthening financing and agribusiness support, research and development (R&D), infrastructural development, and policy interventions to expand national and regional markets internationally. To address these critical issues, the Government of Uganda instituted the National Agricultural Research System (NARS) reform in 2005 to improve agricultural innovation; created the National Agricultural Advisory Services (NAADS) as a means of reforming extension delivery; opened new agriculture-related public universities; and instituted a national agricultural development program, the Plan for the Modernization of Agriculture (PMA), to guide the process. Implementation of such an ambitious development agenda critically depends on the right workforce and agricultural innovations. To this end, Makerere University—the oldest public university in Uganda and the region—plays a crucial role in agricultural innovation and capacity building.

Improving the supply of new knowledge and technologies to stimulate growth in the agricultural sector is gaining focus the world over. Uganda's agricultural sector is a complex system with interactive components that support rural livelihoods and national economic growth. The system depends of demand and supply agents, who are in turn influenced by intermediary actors and factors. With respect to agricultural research and development, farmers are generally considered demand actors and agricultural research institutes as supply actors. In that context this case study investigates the role and contribution of Makerere University as a supply institution within agricultural research and development subsystem of Uganda that has evolved since the 1980s.

The Evolution of Uganda's Agricultural Research System

In 1992, the Government of Uganda amalgamated several research agencies to create the National Agricultural Research Organisation (NARO), based on the national agricultural research system concept, popular in the 1980s (GOU 1988), which sought to strengthen research supply by providing infrastructure, capacity, management, and policy support at the national level (World Bank 2006). Led by the United States Agency for International Development (USAID) and the former International Service for National Agricultural Research, the taskforce that guided the creation of NARO was guided by three main priorities: (1) strengthening the capacity to develop and conduct research effectively and communicate its results, (2) establishing appropriate structures to manage agricultural R&D, and (3) developing research programs that efficiently use resources to address prioritized challenges. At the time NARO was created, Makerere University was recognized as a strong institution of research with 48 PhD- and 36 MSc-qualified scientists; by comparison, the country's public research programs employed

17 PhD- and 112 MSc-qualified scientists (GOU 1988). As a result, during 1992–2005 Makerere University—specifically its Faculty of Agriculture and Forestry and Faculty of Veterinary Medicine—partnered with nine public agricultural R&D institutes.

The NARO Act of 1992 was repealed following review and reform during 2003–04, and new legislation was enacted in 2005 (UNCST 2010) seeking to improve the delivery of agricultural R&D services. The new Act recognized that, to succeed, a national agricultural innovation system would require active cooperation among public and private research agencies, stakeholders, and policymakers. In this context, Makerere University was considered a private research body. Key elements of the national agricultural research system (GOU 2005) include the following:

- a decentralized demand and governance structure involving public and private research agencies interacting with clients;
- broad-based funding, supported by the Government of Uganda and its development partners though core allocations, research for development fund (innovation funds), and competitive research grants; and
- contractual implementation arrangements among national and local farmer organizations and public and private research providers.

The changes in the management of Uganda's national agricultural research agenda enabled Makerere University to compete for research funding from government sources. In 2000, Makerere accounted for about 20 percent of the country's research investments (Beintema and Tizikara 2002), and this share grew to 25 percent in 2005 after the reform (Flaherty, Kitone, and Beintema 2010). Research funds used by NARO, however, remained fairly stable at about 73 percent, which suggests that Makerere University has attracted the additional funding to support its R&D agenda from outside the national agricultural research system.

2. MAKERERE UNIVERSITY'S ROLE IN NATIONAL AGRICULTURAL R&D

In 2008, Makerere University approved a new research and innovation policy to strengthen research capacity and output, and increase its contribution to knowledge and innovation. The policy was coordinated by the School of Graduate Studies and involved a consultative process with various stakeholders from within and outside the University who generate and use research products, and influence research processes. Development of the policy was linked to a university-wide strategic planning process for the purpose of repositioning Makerere to champion social, political, and economic change in Uganda. A key government reference document for the process was the Poverty Eradication Action Plan (PEAP). In addition to the five cross-cutting areas, the policy focuses investments around six themes, four of which relate to (1) agriculture (food, nutrition, and value addition), (2) sustainable environment development, (3) health (infectious and lifestyle-related diseases), and (4) natural resources utilization and conservation. Overall, the policy recognizes and supports agriculture's significant role in the economy.

Developments in Agricultural R&D at Makerere University

Agricultural R&D at Makerere University is conducted at the College of Agricultural and Environmental Sciences (CAES), the School of Veterinary Medicine, and the College of Natural Sciences. Implementation of the University's agricultural research agenda is generally left to Colleges, whose staff members are free to seek funding and partnerships at local, national, regional, and international levels. Support for R&D has become diversified since the 199Os, was and is primarily provided by overseas development agencies (ODA), such as USAID; multilateral development agencies, such as the World Bank; philanthropic agencies, such as the Rockefeller Foundation, Carnegie Corporation, McKnight Foundation, Welcome Trust, Bill and Melinda Gates Foundation; regional bodies such as the Forum for Agricultural

Research in Africa (FARA), Alliance for a Green Revolution in Africa (AGRA), African Union (AU), Association of African Universities (AAU), Association for Strengthening Agricultural Research in East and Central Africa (ASARECA) and Regional Universities Forum for Capacity Building in Agriculture (RUFORUM); economic commissions, such as the European Union; and new ODA partners, such as the Swedish International Development and Cooperation Agency (Sida), Canadian International Development Agency (CIDA), Norwegian Agency for Development Cooperation (NORAD), Japan International Cooperation Agency (JICA), U.K. Department for International Development (DFID), France, and Germany through the German Academic Exchange Service (DAAD). This approach has broadened the scope and number of scientists engaged in agricultural research and development (Table 1). Further strengthening of Makerere University's R&D capacity in recent years is partly attributable to the 2005 creation of the University Directorate of Human Resources, which has strengthened staff development by systematizing the processes of planning, training, recruitment, and promotion.

Table 1. Sources of funding for agricultural R&D at Makerere University, 1990–2011

Funding sources	Nature of grant	Size of grant	Details
a. 1990–2000			
U.S. Agency for International Development (USAID) and the World Bank	Research and training	Small	USAID and World Bank support took the form of nationwide interventions intended to revamp the agricultural and rural development system after civil war; many of these grants were graduate-level scholarships.
Philanthropic foundations	Research and training	Small	During the 1990s, major philanthropic support was provided by the Rockefeller Foundation through the Forum for Research on Agricultural Resource Husbandry (FORUM). FORUM later became the Regional Universities Forum for Capacity Building in Agriculture. Small, multi-year grants average US$60,000–100,000. Other philanthropic agencies providing support during this period included the McKnight Foundation and Welcome Trust. New major agencies supporting agricultural and rural development since 2000 include the Carnegie Corporation and the Bill and Melinda Gates Foundation.
b. 2000–11			
New overseas development assistance (ODA)	R&D, training and infrastructural support	Large (institutional)	The new ODA support is currently being provided by the Norwegian Agency for Development Cooperation, Swedish International Development and Cooperation Agency, Japan International Cooperation Agency, German Academic Exchange Service, and Canadian International Development Agency through the International Development Research Centre. Many of these agencies provide institutional support to Makerere for graduate research at the College of Agricultural and Environmental Sciences, School of Veterinary Medicine, College of Natural Sciences and College of Humanities; Support is also provided university-wide via the Directorate of Research and Graduate Studies. ODA during the 2000s, particularly under Innovations @Makerere (i@mak.com) was funded by the World Bank in partnership with the Rockefeller foundation.
Diverse sources	R&D	Small	
Philanthropic foundations	Research and training	Small	
Regional research agencies	R&D	Medium to large	
Nationally commissioned R&D	R&D, training and infra-structural support	Large (institutional)	

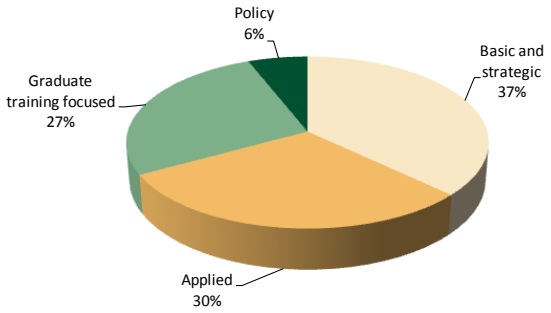
Source: Compiled by author from data available at the Grants Management Office and other relevant university offices.

The Scope of Agricultural R&D at Makerere University

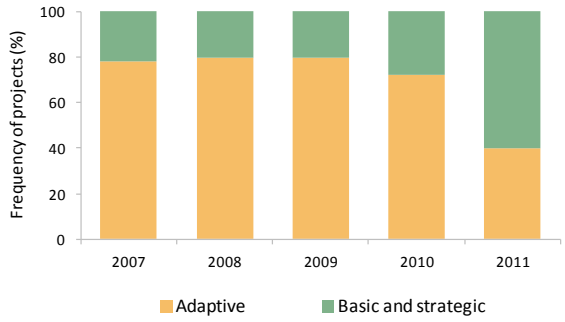
During the 1990s, support to Makerere University was mainly for graduate research addressing national agricultural challenges. Agricultural research topics during that period mainly took the form of scholarly scientific investigations, which markedly improved the number of scientists at Makerere. As of mid-2011, the number of staff engaged in agriculture and its allied disciplines at Makerere University had risen from the 1988 levels of 48 PhD- and 36 MSc-qualified staff, to approximately 180 PhD- and 100 MSc-qualified staff at the College of Agriculture and Environmental Sciences, School of Veterinary Medicine, and College of Natural Sciences (Makerere 2010). This growth includes greater numbers of PhD-qualified staff in both the biophysical and social economic disciplines, and an expanded scope of R&D. From 2009 to 2011 training and research accounted for 27 percent of agricultural R&D activities, while basic and strategic research accounted for about 37 percent, and applied research activities about 30 percent (Figure 1). This improvement in the number and quality of staff members is mainly due to positive institutional changes, such as the reorganization of Makerere's research activities to attract funding at both the central level, through the Directorate of Research and Graduate Training, and at College level as before.

Figure 1. Agricultural research approaches and composition in recent years

a. Agricultural research implementation approaches at Makerere University, 2009–11



b. Changes in the composition of agricultural and rural development undertaken, 2007–11



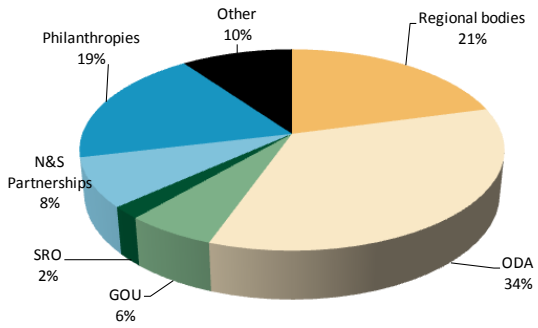
Source: Compiled by author from data available at the Grants Management Office and other relevant university offices: College of Agricultural and Environmental Sciences, the School of Veterinary Medicine, Directorate of Research and graduate studies, and the Grants Management Office of University.

The niche within the national agricultural R&D agenda for Makerere University is within basic, strategic, and specialized areas of applied and policy research. Within applied research, the major activities include community action research, technology promotion, farmer empowerment, and policy and linkages to markets. Strategic research at the College of Agricultural and Environmental Sciences mainly addresses the generation of new technology, environmental conservation, and value addition. As of 2011, the Government of Uganda was supporting strategic science and technology (S&T) activities, not being funded through other sources, in order to develop strategic technologies; Makerere University had received three of the four grants relating to agriculture.

Financing Agricultural R&D at Makerere University

As of 2011, there were six major sources of funding for agricultural R&D at Makerere University: (1) the Government of Uganda, (2) international development departments of foreign governments, (3) regional research and training bodies, (4) subregional research organizations (SROs), (5) philanthropic organizations, (6) North–South partnerships, and (7) cooperative partnerships (Figure 2).

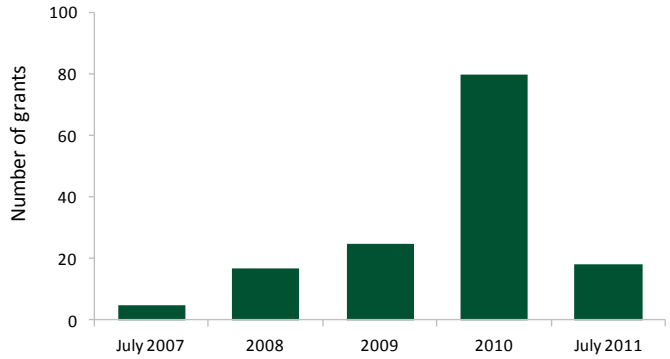
Figure 2. Funding sources for agricultural R&D at Makerere University, 2007–10



Source: Constructed by author.
Note: Shares are based on the frequency of funding support within each category.

Overseas development assistance still remains the major source of funding for agricultural R&D in Uganda, accounting for just over one-third of the funds received. Many of these grants are either institutional support grants or support for international and sub-regional R&D activities. Examples of international projects include the Collaborative Research Support Program supported by USAID, and sub-regional projects such as the Bio-Resources Innovations Network for Eastern Africa Development supported by Sida. European Union support through African–Caribbean–Pacific research grants began in 2008. The centers of the Consultative Group on International Agricultural Research (CGIAR), as well as regional development bodies like AGRA, are also important partners. Between July 2007 and July 2011, the number of projects had grown steadily, peaking in 2010 (Figure 3).

Figure 3. Trends in funding of agricultural R&D activities at Makerere University, 2007–11

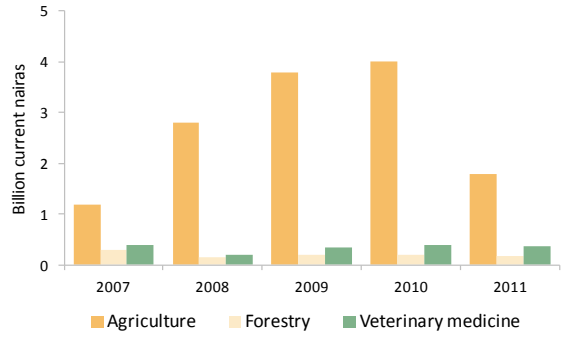


Source: Compiled by author from data available at the College of Agricultural and Environmental Sciences, the School of Veterinary Medicine, Directorate of Research and Graduate Studies, and the Grants Management Office.
Note: Data mainly cover activities conducted at the College of Agricultural and Environmental Sciences.

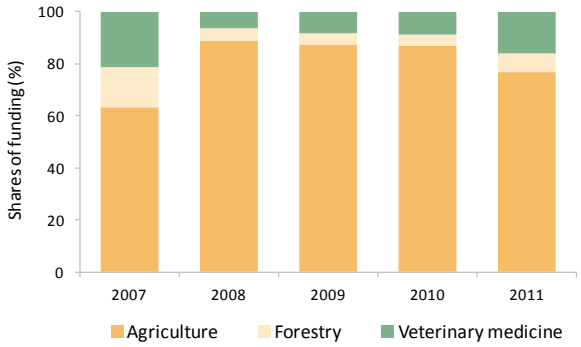
Funding by the Government of Uganda intensified during this timeframe through the Presidential Initiative on Science and Technology, as well as the Uganda Millennium Science Programme, funded through a Loan from the World Bank of up to US$30 million. The Presidential Initiative has involved other universities and R&D institutions, mainly targeting scientists with strategic R&D agendas. No coordinated impact assessment of these investments has been undertaken by the University, but despite this weakness, communication of university research results has been improved, both in terms of scientific and broader audiences. Each month the university hosts a press conference for both print and electronic media profiling successes, which, together with the Internet, has improved the University's visibility. Within Makerere University's CAES is the major actor receiving US$1–4 million per year (Figure 4).

Figure 4. Allocation of agricultural R&D funding at Makerere University, 2007–11

4a. By agriculture-related discipline (US$ million)



4b. By agriculture-related discipline (%)



Source: Compiled by author from data available at the College of Agricultural and Environmental Sciences, the School of Veterinary Medicine, and the Directorate of Research and Graduate Studies.

Capacity Development for Agricultural R&D

The success and impact of agricultural R&D depends in large measure on the quality and quantity of human resource capacity. Agricultural R&D programs at Makerere University invariably couple research with training to address this issue. At the national level, Makerere University is the leader in strategic research and policy information; its major activities are summarized below:

1. Policy research and information. The University hosts the Economic Policy Research Center, which is attached to the Ministry of Finance, Planning and Economic Development of Uganda. The CAES also has its own Agriculture Policy Analysis Center. These two bodies are major sources of policy research and information to the government. Independent scientists also take leadership in this area, for example, in during Uganda's Comprehensive Africa Agriculture Development Programme (CAADP) roundtable process. .

2. Strategic R&D. Makerere University is supported by the Government of Uganda in developing technologies to expand niche markets for agricultural commodities and secure the productivity of agricultural systems. Investments include the Presidential Initiative on Banana Industrial Development, which receives about US$3 million per year to develop various banana products. In 2011, the first batch of processed banana under the brand name "Tooke" was exported to the Middle East (About 1 ton). The University has also received US$1.6 million to develop valued-added cereal products and diagnostic tools for animal diseases, such as trypanosomiasis in cattle, as well as poultry vaccine research.

3. Support to agricultural extension and other development services. Makerere University's agricultural science graduates provide support to services that provide extension, R&D, finance and credit, training, and development. BSc graduates supply many of the country's growing needs, with the exception of activities that require the expertise of MSc- or PhD-qualified scientists. The agricultural science BSc programs have a 95-percent completion rate, with the University producing 630 new graduates each year. Whilst agricultural science graduate programs at Makerere and other universities with a 40-percent completion rate produce about 150 graduates each year. As of 2011, the University has adopted systems of operation to improve efficiency and hence completion rates. The Ministry of Agriculture deploys BSc-level graduates to guide extension services in 900 sub-counties of Uganda with different agroecological conditions farming systems.

4. Supporting research innovation. The University has transformed its R&D agenda to enhance responsiveness to client needs. Participatory R&D and community action research have been initiated,

integrating the University into Uganda's rural transformation processes. The Innovations at Makerere Committee Programme (i@mak.com), supported the creation of satellite outreach stations, whereby University researchers engage in innovation with communities. Soil fertility management tools were developed through this approach, for example. Integrated development initiatives involving public health and agricultural management for wetlands have also been piloted. Farmer field schools have been established to promote farmer involvement (Isubikalu et al. 2000). Other new technologies developed include cowpea and soybean varieties. MAKSoy, for example, is a premier variety grown by over 60 percent of farmers in Uganda, as well as in Kenya and Tanzania.

5. Emergent development challenges. Sub-Saharan Africa is already severely and disproportionately affected by climate change, and yet has the least capacity to respond (Boko et al. 2007). By 2050, some areas in Sub-Saharan Africa are estimated to have up to 10 percent less rainfall per year (Nyong 2005). Reduced rainfall would cause crop failure, reduce food security, and slow down economic growth. Recognizing these challenges, Makerere University is developing a Climate Change Resilience Center—the first of its kind in the country. The center will implement a new masters program, conduct research, contribute to policymaking, and conduct short courses. The center already operates a competitive grant scheme, including five sub-grants that support MSc training.

6. Training for regional agricultural R&D needs. At undergraduate level, the average number of non-nationals trained at Makerere University is still low, because the programs are almost exclusively funded by Government of Uganda and have a limited space for foreign students; there are also numerous undergraduate universities in the region. Nevertheless, 1–3 percent of bachelors students in biophysical programs are non–Ugandan, and in socioeconomics programs, especially those that admit private paying students, the share is up to 10 percent. Regional presence of Makerere University is more prominent at the graduate level, but is also increasing in many regional universities within the country. Together with RUFORUM, Makerere University is the center of leadership for plant breeding, seed systems and biotechnology (Blackie and Woomer 2005). Two regional programs—one a PhD program in Plant Breeding and Biotechnology, and the other an MSc program in Plant Breeding and Seed Systems—have about a 50-percent population of foreign students from Burundi, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Sudan, Tanzania, Zambia, and Zimbabwe. Makerere is also host to the Collaborative Masters in Agricultural and Applied Economics a program, hosted in partnership with the African Economics consortium. Both the plant breeding and seed systems and applied and agricultural economics masters graduate programs have a staff development program for weaker institution. Despite the contribution of Makerere University to developing capacity for agricultural extension, linkages between extension workers and farmers are still lacking (NAADS 2002, 2003).To reduce the staffing deficit in public agricultural extension, the University developed the BSc degree in Agricultural and Rural Innovation (among other programs), which takes about 60 students each year (BARI 2008) (Table 2). The program produces graduates who support rural transformation by nurturing entrepreneurship, increasing productivity, empowering the community, and enhancing the use of knowledge and innovation. Other public universities in Uganda (Gulu University, Uganda Christian University, and Mountains of the Moon) add up to 80 additional graduates, most of whom (more than 85 percent) are employed within a year of graduation, mainly in the public service (Mak 2006).

7. Addressing agricultural R&D capacity needs. Makerere University produces about 150–200 graduate level personnel in fields related to agriculture (Mak 2011). At least 60 percent of the graduates are engaged in agricultural R&D and extension, with 20 percent involved in policy as managers, and 5 percent absorbed by the University. Thus, the staff deficit for senior scientists can easily be met by Makerere University. When seven Zonal Agricultural Research and Development Institutes were created following the 2005 reform of NARO, staff complements was easily met by graduates from Makerere

University was easily able to provide the necessary new staff from its graduates. More than 30 young scientists joined ZARDI in 2005. The College of Agriculture and Environmental Sciences is projecting an increase in its training capacity of up to 53 percent per year by 2020.

8. Supporting national agricultural development. Uganda is a member of CAADP and launched its investment plan, the Development Strategy and Investment Plan (DSIP) to reinvigorate the agricultural sector (GOU 2010b). The Plan clarifies four programmatic areas of investment needed to stimulate Uganda's agricultural growth. The Plan's development objectives are (1) increasing rural incomes and livelihoods, and (2) improving household food and nutrition security. The immediate objectives are (1) sustainably enhancing factor productivity of land, labor, and capital in crops, livestock, and fisheries; (2) sustainably developing markets for primary and secondary agricultural products at local, regional, and international levels; (3) developing favorable legal, policy, and institutional frameworks to facilitate expansion of the private sector and increase profitability throughout the value chain; (4) elevating Ministry of Agriculture Animal Husbandry and Fisheries (MAAIF) and departments to ensure they function within a modern, innovative, accountable, and supportive environment (GOU 2010b). These objectives are being implemented through four programs that align with CAADP's foundational pillars (Box 1).

Table 2. Student populations in different agriculture-related degree programs and at Makerere University

	Annual student population			Annual student population	
Undergraduate program	**Capacity**	**Admitted**	**Postgraduate program**	**Capacity**	**Admitted**
COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES					
School of Agricultural Sciences					
BSc Agriculture	60	55	MSc Crop Science	40	30
BSc Land Use and Management	60	50	MSc Animal Science	10	7
Bachelor of Agricultural and Rural Innovations	60	52	MSc Soil Science	10	17
			MSc Agricultural Extension	17	10
Bachelor of Agribusiness Management	80	50	MSc Plant Breeding and Seed Systems	10	16
BSc Horticulture	30	24	MSc Agricultural Economics	15	10
			Master of Applied and Agricultural Economics	18	10
			Master of Agribusiness	18	10
			PhD	5	5
			PhD Plant Breed and Seed Systems	10	22
Subtotal	**290**	**231**		**153**	**137**
School of Forestry Environmental and Geographical Sciences					
Bachelor of Forestry	40	30	MSc Land Use and Regional Development	30	20
BSc Community Forestry	27	20	MSc Forestry	15	5
BSc Social and Entrepreneurship in Forestry	30	27	MSc Agroforestry		5
BSc Conservation Forestry and Production Technology	30	27	PhD Forestry	5	3
BSc Environmental Sciences	80	65	MSc Environment and Natural Resources	50	30
BSc Wood science and Technology	14	14	PhD Environmental Science	13	10
			Postgraduate Diploma Impact Assessment	20	5
			Postgraduate Diploma Information Management	20	5
Subtotal	**221**	**183**		**143**	**83**
School of Food Technology, Nutrition and Bioengineering					
BSc Food Science and Technology	40	30	MSc Food Science	10	5
BSc Human Nutrition	20	20	MSc Agricultural Engineering	5	-
BSc Food Processing Technology	28	20	MSc Applied Human Nutrition	20	10
BSc Agricultural Engineering	28	20	PhD	10	3
Subtotal	**116**	**90**		**34**	**18**
COLLEGE OF VETERINARY MEDICINE, ANIMAL PRODUCTION AND BIOSECURITY					
BSc Veterinary Medicine	26	24	MSc Food Animal Health Production	10	5
BSc Laboratory Technology	80	60	MSc Molecular Biology	20	18
BSc Wildlife Health and Management	10	5	MSc Veterinary Pathology	10	5
Bachelor of Animal Production and Technology Management	23	10	MSc Veterinary Preventive medicine	10	5
			MSc Livestock Development Planning	10	5
			MSc Biomedical Laboratory Technology	10	5
			MSc Animal Production	10	6
			MSc Natural Production Technology	10	6
			PhD	10	5
Subtotal	**139**	**99**		**100**	**60**
c. College of Natural Sciences					
BSc Fisheries and Aquaculture	20	15	MSc Botany and related programs	100	40
BSc Botany	60	40	MSc Zoology (Fisheries)	30	20
			PhD	13	6
Subtotal	**80**	**55**		**143**	**66**
Total	**846**	**658**		**573**	**367**

Source: Compiled by author from academic records of Makerere University.
Note: Figures are averages of yearly intakes for 2009–10.

In response to DSIP, the University undertook to develop and support an industrial pilot center and incubation plant for value-added agricultural products for its graduates and the public. The center provides both processing infrastructure and technical support to entrepreneurs and industry from within and outside of the university to pilot the development of new products. Current activities include the incubation of meat products, value-added cereal products, and fish, dairy, and fruit and vegetable processing. The center is also supported by the Makerere University Private-Sector Forum, which links the university with the Uganda Manufacturers' Association (UMA).

Box 1. Areas of focus of Uganda's Development Strategy Investment Plan

Program 1. Enhancing production and productivity (Pillar I)
Program 2. Improving market access and value addition (Pillar II)
Program 3. Improving the enabling environment for agriculture (Pillar I and Pillar III)
Program 4. Strengthening policy harmony and evidence- based implementation of policy development

The CAADP pillars addressed by DSIP programs are indicated in parentheses. Makerere University contributes to Programs 1, 2, and 3 by training graduates who focus on extension, R&D, and innovation products that increase factor productivity. The university's policy research contributes to Program 3.

Source: GOU 2010b.

New demand-based programs, designed with the involvement of both employers and trainers, and with centralized quality assurance by the university and the Ministry of Education's National Council for Higher Education, reflect the universities commitment to support national development (Table 2). In 2010 the university reviewed all programs to reduce redundancy and ensure efficiency. The process led to the merger of some courses and the removal of outdated courses, as well as joint teaching in cases where staff is limited.

3. CONCLUSIONS

Uganda's agricultural development agenda is mainly guided by CAADP. To support development imperatives, Makerere University is learning as it engages in agricultural R&D and develops human resource capacity. At 89 years old, the University has contributed to national and regional development by strengthening the country's overall agricultural R&D capacity, as well as engaging with the community to meet the needs of a growing agricultural sector through the following activities.

1. **Intensifying efforts** to engage with the community through action research and student placement programs and internships; all graduates of Makerere must now undertake an internship within the agriculture and other sectors of the economy; field stations also support technology transfer
2. **Addressing new threats,** such as climate change, to strengthen the resilience of communities so they remain robust in the wake of threats like transboundary animal and human diseases, or zoonosis
3. **Supporting R&D** through innovative programs that involve communities and researchers
4. **Aligning training** programs with national and regional development agendas through regular reviews and the creation of innovative training programs
5. **Mainstreaming gender** in all research and training programs to ensure equitable development; undergraduate programs in biophysics have achieved a 20–30 percent share of female students, while socioeconomic programs have achieved a share of up to 40 percent; graduate programs still have low female participation, ranging between 15 and 25 percent
6. **Developing new client-** and development-oriented programs; 26 new programs have been developed in the past five to eight years
7. **Developing new strategic partnerships** to support its R&D and training programs.

Overall, Makerere University, through its new constituent colleges, particularly CAES and the School of Veterinary Medicine, are making significant contributions to agricultural development by engaging in and supporting agricultural R&D for Uganda and the broader region.

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The Agricultural Science and Technology Indicators (ASTI) initiative compiles, analyzes, and publishes data on levels and trends in agricultural R&D investments, capacities, and institutional arrangements in developing countries. ASTI is managed by the International Food Policy Research Institute (IFPRI) and involves collaborative alliances with many national and regional R&D agencies.

Jointly convened by ASTI/IFPRI and the Forum for Agricultural Research in Africa (FARA), the conference, "Agricultural R&D -- Investing in Africa's Future: Analyzing Trends, Challenges, and Opportunities," brought together experts and stakeholders from the region to contribute their expertise for the purpose of distilling new insights and creating synergies to expand the current knowledge base. The themes under focus were (1) Why African governments under invest in agricultural R&D; (2) How human resource capacity in agricultural R&D can be developed and sustained; (3) How institutional structures can be aligned and rationalized to support agricultural R&D; and (4) How the effectiveness of agricultural R&D systems can be measured and improved.

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