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ENHANCING CAPACITY FOR AFRICAN AGRICULTURAL RESEARCH

Selected Models and Lessons

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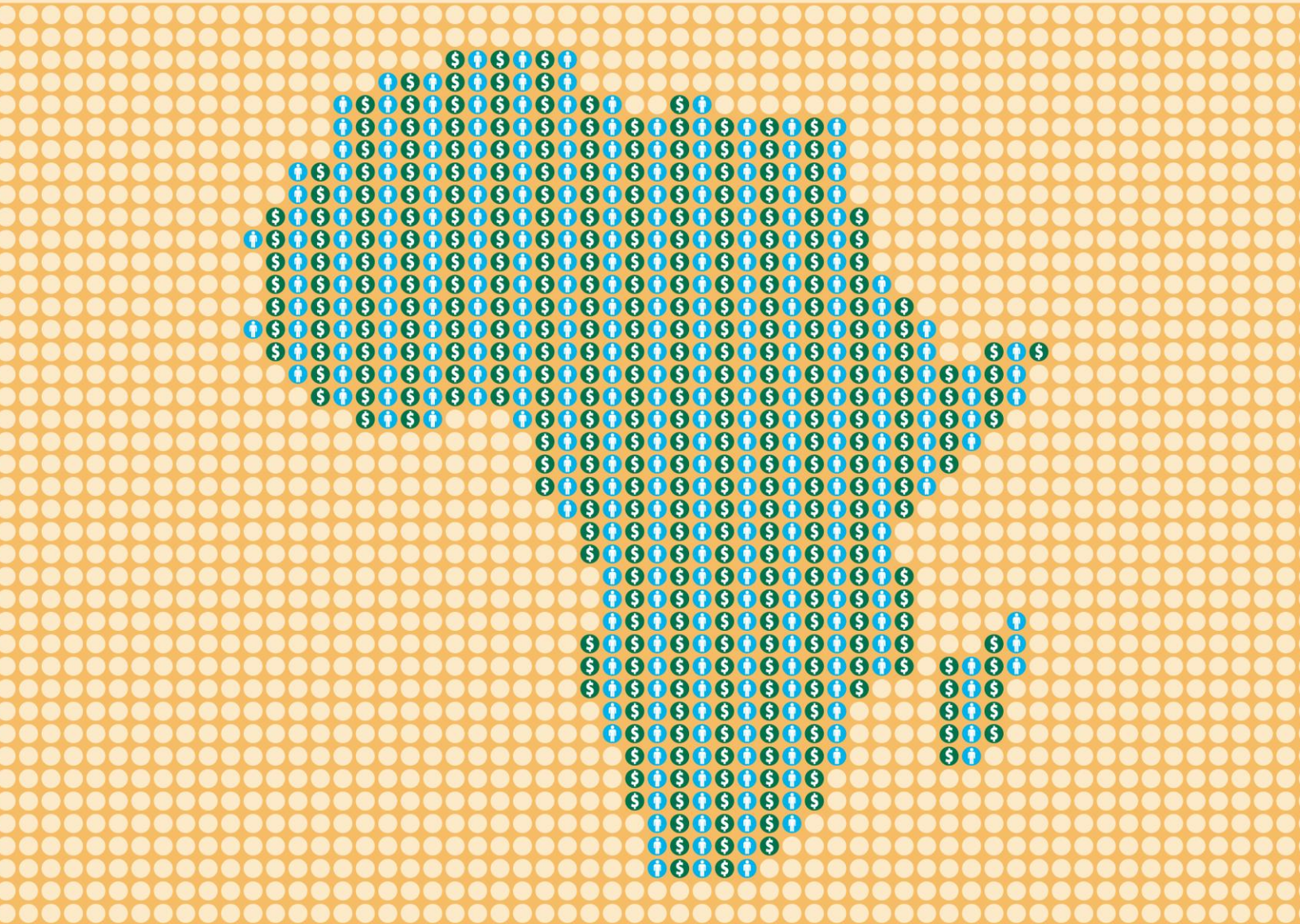
AGRICULTURAL R&D: INVESTING IN AFRICA'S FUTURE
Analyzing Trends, Challenges, and Opportunities



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Acronyms and Abbreviations

ACCI	African Center for Crop Improvement
AERC	African Economic Research Consortium
AGRA	Alliance for Green Revolution in Africa
ANAFE	African Network for Agro-Forestry and Natural Resources Education
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
CAADP	Comprehensive Africa Agriculture Development Programme
CMAAE	Collaborative Masters Program in Agricultural and Applied Economics
CORAF/WECARD	West and Central African Council for Agricultural Research and Development
DAAD	German Academic Exchange Service
DFID	UK Department for International Development
ERS–USDA	Economic Research Service of the United States Department of Agriculture
FARA	Forum for Agricultural Research in Africa
FTE	full-time equivalent
IFPRI	International Food Policy Research Institute
NARO	National Agricultural Research Organization [Uganda]
NARIs	national agricultural research institutions
NARS(s)	national agricultural research system(s)
NGO(s)	nongovernmental organization(s)
NEPAD	New Partnership for Africa's Development
R&D	research and development
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
SADC	Southern African Development Community
SCARDA	Strengthening Capacity for Agricultural Research in Development in Africa
SRO(s)	subregional organizations
SSA	Sub-Saharan Africa
UGX	Uganda shillings
ZEF	Centre for Development Research of the University of Bonn

Abstract

This paper presents a review of three existing models of capacity building to provide an understanding of strategies and approaches that have been successful in strengthening human and institutional capacity for agricultural research in Africa. The paper documents lessons in capacity strengthening from these models that can be scaled up and out to other contexts. While the three programs reviewed emphasize building capacities by developing local institutions, a major challenge is the programs' sustainability because they continue to depend on external sources of funding. In order to take advantage of the emerging global interest in capacity strengthening, it is argued that national agricultural research systems need to prepare by identifying their strategic capacity and institutional strengthening needs, as well as providing overall leadership to enable the successful use of the capacities developed. While further innovations are needed to strengthen capacities cost-effectively, the three programs reviewed highlight the role of national leadership in absorbing the capacity created, thereby emphasizing the importance of an enabling environment that can maximize the benefits of the capacities strengthened. Unless the skills developed through these programs are complemented by effective organizational capacity, providing the motivation and incentives needed to put the newly created skills to effective use, these capacities may well be eroded.

1. INTRODUCTION

The urgent need to develop capacity for agricultural research, technology dissemination, and adoption in Sub-Saharan Africa (SSA)—as outlined in Pillar IV of the Comprehensive African Agricultural Development Program (CAADP) under the New Partnership for Africa's Development (NEPAD)—has become increasingly clear. Recent progress made in mobilizing African leadership under CAADP will require greater focus on agricultural research capacity as a means of successfully reducing poverty and eliminating hunger (FARA 2006; CAADP 2008; NEPAD–CAADP 2010). Along with the development of national investment plans, the capacity to implement such plans needs to be strengthened and become an integral part of the agricultural research and development (R&D) processes if the goal of increasing agricultural productivity by 6 percent per year is to be fully realized. A major challenge is that existing capacity strengthening approaches focus heavily on the development of individual skills rather than the institutional and organizational capacity challenges facing African countries.

It is well known that transforming traditional agricultural sectors requires adequate human organizational capacity (Mosher 1966; Timmer 2011); however, a systemwide effort to develop a framework for designing, implementing, monitoring, and evaluating capacity strengthening programs has been lacking. Capacity development efforts continue to be confronted with numerous challenges, and the approach to strengthening research capacity has been fragmented. For example, several donors fund capacity strengthening programs within institutions with little coordination, past emphasis on strengthening individual skills of researchers has not resulted in adequate organizational capacity, developing individual research capacity does not guarantee successful use of such capacity at the organizational and institutional levels, and capacity development efforts often do not emanate from agricultural development strategies and national development goals.

The CAADP process provides an opportunity to develop a systematic approach to strengthening agricultural research in line with the national strategies. Existing approaches face the classic development dilemma of whether to address immediate problems, such as low productivity, degraded natural resources, lack of market and trade opportunities, and ineffective institutions for accelerated agricultural development, or to focus efforts long term, in this case on developing the capacity to design and implement future programs (Fukuyama 2004). In the context of agricultural research, both problem-solving and long-term capacity development need to be addressed simultaneously so that newly initiated research programs can be sustained. Yet research institutions, like other development agencies, are pressured to focus on short-term objectives to show quick impact. Thankfully, policymakers and development partners are increasingly recognizing the need to develop long-term capacity.

This paper presents a review of three existing models of capacity building as a basis for addressing the following questions: What strategies can help overcome the conflict between short- and long-term capacity development needs? What approaches have been successful in developing individual research capacity, while building sustainable institutional capacity? What can be learned from existing models of capacity strengthening efforts under the CAADP process that can be scaled up and out to other contexts?

2. THE COMPREHENSIVE AFRICAN AGRICULTURAL DEVELOPMENT PROGRAM

The CAADP process is driven by the implementation of four strategic pillars (CAADP 2008):

1. extending the area under sustainable land management and reliable water control systems (Pillar I);
2. improving rural infrastructure and trade-related capacities to improve market access (Pillar II);
3. increasing food supply and reducing hunger (Pillar III); and
4. agricultural research, technology dissemination, and adoption (Pillar IV).

The specific objectives of Pillar IV are (NEPAD–CAADP 2010):

1. to develop technologies, policies, and institutional innovations that provide solutions to poverty and resource degradation in Africa;
2. to test the adaptability of these options in a participatory and iterative fashion, from the farm to the regional scale;
3. to develop appropriate mechanisms for broad dissemination and adoption of technologies and for the implementation of sustainable and supportive policies and institutional options; and
4. to empower Africa's resource-poor farmers in sustainably managing their natural resources and systems.

Along with these four pillars, two cross-cutting areas support the four pillars: the development of (1) academic, professional, and vocational capacity, and (2) strategy and knowledge management capacity. In order to implement the CAADP process, it is important that adequate capacity be developed across all the four pillars in order to jointly address national capacity strengthening needs (CAADP 2008). Under the CAADP process, continuous engagement with stakeholders and the public is seen as a way to address the challenges facing the final beneficiaries. The programming and policymaking process must be evidence-based, which requires research, analysis, and monitoring and evaluation capacity. Enhanced institutional arrangements and enabling environments for program development and implementation are needed to ensure success. The programs implemented under CAADP must be constantly assessed for learning, adaptation, and further planning through revision.

At the country level, CAADP country teams engage in developing strategies for agricultural development, but these teams need to be supported with policy analysis and research to generate appropriate evidence for the strategies that are identified. Human and organizational capacity requires strengthening to be able to develop the strategy and implement policies and programs once investment opportunities are identified. In the process of developing in-country capacity for the CAADP design and implementation, it is important to recognize the various actors that constitute CAADP's resource group, including NEPAD, the African Union, the regional economic communities, and national policymakers.

Nurturing relationships between country teams and various groups of experts is an important aspect of securing long-term success in implementing CAADP strategies and ensuring that national representatives are aware of CAADP's institutional implementation architecture so they can protect their interests. In the context of building agricultural research and innovation capacity, the national agricultural research institutions (NARIs) need to align their priorities with strategies developed through CAADP's country processes. These processes have significantly improved the way in which priorities are identified and aligned with local needs, but strategic approaches are needed to improve efficiency in terms of maximizing the use of available resources.

Uganda's agricultural sector development strategy and investment, 2010/11–2014/15, for example, was developed as part of the CAADP process. It identifies "enhancing production and productivity" as a strategy and investment program, and "agricultural research and technology development" as a subprogram that calls for strengthening national agricultural research systems (NARSs) to generate new technologies along value chains and ensure continuity in research capacity in the pursuit of cutting-edge science (MAAIF 2010). This objective is further aligned with the Ten-Year Strategic Plan (2008–18) of Uganda's National Agricultural Research Organization (NARO), which identifies maintaining a critical mass of scientists as a key factor in improving the provision of the country's agricultural research. Additional strategies identified as requiring capacity strengthening include enhancing the priority-setting process for research, developing a center of excellence for cassava, expanding the competitive grant system for funding research, and designing mechanisms for assessing the impact of NARO's research programs. Budget allocation for this subtheme includes 16.7 billion Uganda shillings (UGX) for training and workshops, which represents 4.8 percent of this subprogram's total funding of UGX 3.44 billion for the period 2013–18. The challenge, however, is to strategically reallocate the minimal resources available to achieve capacity strengthening objectives. While additional resources could be raised

through special projects funded by bilateral donor agencies (a strategy that also has inherent problems), meeting the critical objectives with limited government funding is a challenge facing many SSA countries. Assuring the quality of the capacity developed is another critical factor, as is the need to establish a system of accountability, inclusiveness, and collective responsibility for the regionwide development of competencies in agricultural research and innovation systems. Simply coordinating such processes will require additional capacity and leadership at the national level.

The CAADP process emphasizes that capacity development must meet the demands of stakeholders in terms of identifying current gaps, efficient approaches, and ways of transforming existing and new capacity to enable the effective implementation of programs. Additional key elements for success include contextualizing the capacity development process, promoting mutual learning and knowledge sharing, adopting best global standards, and prioritizing institutional and organizational development. This provides initial benchmarks against which current capacity development approaches can be analyzed for their contribution to the CAADP process.

3. REVIEW OF THREE EXISITING CAPACITY STRENGTHENING APPROACHES FOR AGRICULTURAL RESEARCH

The Asian experience in strengthening national research capacity may be relevant for Africa, as discussions on improving African agricultural productivity often indicate (Otsuka and Kijima 2010; Swaminathan 2003); however, several factors contrast Asia's Green Revolution experience with the capacity challenges facing Africa today. For example, whereas only two major crops (rice and wheat) contributed to the Green Revolution in Asia, African agriculture is characterized by multiple agroecological systems growing several crops within a single zone (Eicher 2006; Timmer and Akkus 2008). Nevertheless, the development of capacity for agricultural science and technology during the initial period of Green Revolution in India could be illustrative. India, for example, had only 7,000 graduates and 1,000 postgraduates in 1950, but investment in higher education in the 1960s contributed to increasing these numbers threefold. By 1971, graduates and postgraduates numbered 13,500 and 4,200, respectively (Long 1979). This significantly larger pool of scientists provided the basis for sustaining the Green Revolution into the 1970s and 1980s. While India had the minimum needed capacity to conduct adaptive research in the early 1960s, much of its capacity was developed through the process of implementing Green Revolution technologies, institutions, and policies (Lele and Goldsmith 1989). Such capacity for adaptive research is currently available in Africa, albeit at minimum levels and thinly spread across the region, in part based on Africa very large number of small countries (54 currently) combined with the large number of crops that provide the continent with staple foods and thereby preclude scale economies.

The lessons for capacity strengthening from the Green Revolution can be summarized as follows:

- Capacity development for agricultural research in Africa must go hand in hand with program implementation.
- Capacity development at the level of professional individuals needs to be complemented by institutional and organizational capacity.
- Capacity investment should be an integral part of research investments in order to maximize and sustain research to obtain the desired impacts.
- In addition to developing individual capacities, institutions that generate human capacity for agricultural research, technology development and dissemination, and strategic policy analysis must be strengthened (Eicher 1994; Timmer 2011; Tamboli and Nene 2011) in order to generate sustainable capacity for agricultural research.

Table 1 shows the trend in capacity levels for agricultural research in selected countries in SSA over the past 40 years. While there has been considerable progress in strengthening research capacity in several of the region's countries, the capacity developed is not adequate to meet the goal of increasing agricultural productivity by 6 percent, as agreed under CAADP (Beintema and Stads 2011).

Table 1. Trends in public agricultural researchers in Africa by country, 1971–2008

	Total number of researchers (full-time equivalents)				
Subregion/country	**1971**	**1981**	**1991**	**2000**	**2008**
East Africa					
Burundi	27.6	74.6	199.0	76.6	107
Eritrea	–	–	–	85.8	122
Ethiopia	56.4	115.3	388.7	740.0	1,318
Kenya	297.3	453.7	953.0	822.3	1,011
Rwanda	–	–	–	–	104
Sudan	127.3	324.0	516.4	779.7	1,020
Tanzania	na	na	na	542.3	674
Uganda	107.7	209.2	225.5	244.9	299
Subtotal (9)	760.9	1,452.8	2,817.9	3,291.7	4,655
Southern Africa					
Botswana	20.2	46.9	58.5	95.5	97
Madagascar	90.9	107.2	179.2	202.2	212
Malawi	63.9	119.6	155.3	154.3	127
Mauritius	38.0	72.0	116.2	147.0	158
Mozambique	–	–	–	–	263
Namibia	–	–	–	–	70
South Africa	678.0	807.4	1,047.0	1,028.6	784
Zambia	136.8	182.7	204.6	178.8	209
Zimbabwe	–	–	–	–	139
Subtotal (9)	1,027.8	1,335.7	1,760.8	1,806.5	2,059
West Africa					
Benin	16.5	56.3	97.3	143.6	115
Burkina Faso	28.5	97.9	176.6	260.5	240
Congo	na	na	105.7	134.7	71
Côte d'Ivoire	131.4	179.7	273.2	153.9	123
Gabon	na	na	27.3	53.14	61
Gambia	na	na	32.3	47.3	38
Ghana	133.1	192.0	327.3	474.5	537
Guinea	na	na	219.5	269.3	229
Mali	na	203.4	306.6	300.3	313
Mauritania	na	na	70.6	97.7	74
Niger	13.7	47.7	99.4	108.7	93
Nigeria	366.2	908.3	1,135.8	1,351.9	2,062
Senegal	76.8	193.1	194.8	150.9	141
Sierra Leone	–	–	–	–	67
Togo	15.0	59.2	108.0	102.4	63
Subtotal (15)	1,028.8	2,233.4	3,174.2	6,648.5	4,227
Total (32)	2,817.5	5,022.0	7,752.9	8,746.8	10,941

Source: Beintema and Stads 2006, 2011.
Note: na indicates that data were not available.

In the past decade, all the East African countries have improved their research capacity; among Southern African countries, Malawi and South Africa have reduced capacity; and in West Africa, capacity in several countries has fallen, while improvements were recorded in Gabon, Ghana, Mali, and Nigeria. In average terms, however, full-time equivalent (FTE) researchers per million employed in the labor force increased only slightly, from 63 FTEs in 1981–85 to 68 FTEs in 2008. The yearly rates of growth in FTE researchers have also declined from 4.5 percent in the 1970s to 2.8 percent in the 2000s (Beintema and Stads 2011). These trends reflect the challenge of sustainably increasing agricultural research capacity in African countries.

Given these trends, some core principles should underlie ongoing efforts to generate and retain agricultural research capacity for the benefit of African agriculture:

- build capacity as cost-effectively as possible in areas of research that contribute to issues and crops of relevance to African countries within the context of national priorities;
- minimize the time researchers/students spend away from home by maximizing opportunities for learning and retaining the capacity developed within recipients' home countries; and
- design curricula to include state-of-the-art methods and cutting-edge knowledge.

The next sections review the three chosen models of capacity development in turn.

African Center for Crop Improvement of the University of Kwazulu-Natal, South Africa: PhD program in Plant Breeding[1]

The Challenge

Plant-breeding skills can be considered among the most important gap in capacity to meet the CAADP goal of increasing agricultural productivity in Africa. Emerging challenges, such as population growth, high food demand, rising food prices, climate change, and the energy crisis, all require increased productivity of African crops. Increasing crop yields, producing higher quality foods, fighting biotic and abiotic factors, and maintaining the productivity gains all require sound plant-breeding capacity within NARIs.

The Program

The program began in 2002 at the African Center for Crop Improvement (ACCI) of the University of Kwazulu-Natal in South Africa.[2] The program works with NARIs in East and Southern Africa to identify young researchers to work with experienced plant breeders as part of their PhD training, supported by the Alliance for Green Revolution in Africa (AGRA). ACCI currently trains plant breeders from 10 countries in East and Southern Africa: Kenya, Ethiopia, Malawi, Mozambique, Rwanda, South Africa, Tanzania, Uganda, and Zambia. ACCI has predicted that 440 breeders are needed in crop improvement research focusing on 11 crops; yet, as of 2011, ACCI had only trained 84. Although other breeding programs will add to this number—such as the PhD program run by Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) and MSc-level programs in Mozambique, Tanzania, and Uganda—the demand for plant breeders in the subregion far exceeds the current supply (Laing 2011).

The Approach

The program follows a "sandwich" approach. Students undergo rigorous theoretical training and development of practical plant-breeding techniques for the first two years of the program at Kwazulu-Natal University. Subsequently they select a research problem related to their home countries and conduct plant-breeding research in collaboration with their local NARIs, at which many of the students are also employed. The research

[1] This section draws on ACCI reports and publications, along with consultations with several people associated with the program, including its director, Mark Laing.

[2] A second phase of the program for the countries of West and Central Africa was recently initiated at the University of Ghana, Legon; this review, however, focuses on the South Africa phase of the program.

is supported and supervised by professors of the University of Kwazulu-Natal, to which the final PhD thesis is submitted for assessment. The program also brings in professors from Cornell University to teach plant-breeding courses, which has been a useful way of exposing participants to additional external expertise, to the most current research methods and knowledge of plant breeding, and to mentorships that go beyond their training. Importantly, because participants work to improve crops of national priority, the outcomes of their research are highly relevant.

The Achievements

The program has been instrumental in developing several crop varieties that have been shared with national agricultural research programs. It strengthens researchers' capacity by imparting specific plant-breeding skills and techniques and by proving consistent mentoring. In most cases the thesis research aligns with national research priorities, as well as promoting continuity and new employment for newly trained researchers in their own countries. Increasingly, the capacity developed by the program is being absorbed and retained in the subregion. On average, eight students have been trained per year, with a 75-percent graduation rate. Most of the students' research has been published in international journals, and the students have developed, registered, and released new varieties of crops, including hybrids. The program has produced high-quality research outputs in the past six years, including (as of late-2011) 66 published research papers and books; 33 research papers accepted for review; and 37 research papers in preparation for submission to journals (Laing 2011).

The Cost

The program's funding for the 2002–18 period totals US$18 million. The yearly cost of educating a student is US$10,483, which compares well with some of the programs in North America, which cost about twice as much per year. ACCI probably has the largest group of plant breeders in Africa, including nine full-time breeders to conduct teaching and research. The institute continues to take in new students, in addition to the existing 44 students who will graduate in the next four to five years. ACCI intends to make some modifications in the next phase of its implementation, including reducing the curriculum to four years instead of the current five; the goal is to admit students with MSc degrees in plant breeding, thereby eliminating a year of more fundamental coursework needed by nonplant-breeders. The program is also planning to hire permanent, university-funded staff as a means of sustaining impact, while hopefully reducing costs.

Collaborative Masters Program in Agricultural and Applied Economics in Eastern, Central, and Southern Africa[3]

The Challenge

Existing nationally based agricultural economics education in Africa generally lacks the ability to provide comprehensive postgraduate programs, but higher education agencies do have small numbers of well-trained faculty staff who could contribute specialized expertise to high-quality programs structured at the regional or subregional levels. Lack of ability to come together at the regional level has been a major constraint to utilizing existing teaching capacity in regional development initiatives. Additionally, strong MSc-level graduates are needed to fill teaching positions and conduct research within the higher education sector in East, Central and Southern Africa.

The Program

The Collaborative Masters Program in Agricultural and Applied Economics (CMAAE) was established in 2000. It is a network of 16 faculties of agricultural economics and agribusiness in 12 countries of Eastern, Central, and Southern Africa.

[3]This section is primarily based on reports of the CMAAE program and on personal conversations with those involved in the program.

CMAAE's major goal is to bring together specialized capacities from a variety of geographically dispersed university departments and faculties to contribute to building future capacity for agricultural economics and policy research. The program's three specific objectives are (1) to produce high-quality MSc agricultural and applied economics graduates; (2) to upgrade the teaching and research capacity of departments currently in the program, and initiate strategic plans to scale out the program to other subregions of SSA; and (3) to strengthen a continent-wide research network to promote agricultural development.

The Approach

The key approach of the program is to tap the best brains in Africa as teachers at the regional level. Students receive their degrees from their participating home-based universities, but they have opportunities to learn as a collective group from regional and international experts in a variety of fields of agricultural economics and policy research. Competitive research grants for thesis research are provided through the network, and students are competitively selected to participate in the program. The research conducted by the students is evaluated by an external team in order to maintain the quality of the research. Given that CMAAE is a network of teachers and teaching programs in agricultural economics, lessons from each of the universities can be shared and applied via a standardized curriculum that focuses on challenges that are common to the region. Students select their thesis research to address the economic policy challenges of their home countries and the countries in which they are studying. While the capacities generated are not necessarily tied to local organizations, the network creates general capacities for agricultural economics, farm management, program management, project monitoring and evaluation, and policy analysis in various fields related to food, agriculture, and natural resource management.

Preparatory stages of the program began in 2001 and involved a thorough analysis of the demand for postgraduate programs in agricultural economics (Obwana and Norman 2001). The planning process was guided by a steering committee, which developed a proposal in collaboration with the International Food Policy Research Institute (IFPRI). Initial funding was provided the Rockefeller Foundation and enabled the establishment of a planning secretariat and a network of collaborating institutions. Between 2002 and 2004, several consultative meetings were held to develop strategic plans, client consultations, governance structures, and operating procedures. The planning process identified a number of key features for the program, including that it (1) be demand driven, (2) provide opportunities for mid-career professionals, (3) pool and share existing human and physical resources, (4) be expanded into innovative applied programs, (5) prepare students for further education, (6) focus on research-based education, (7) complement existing programs, and (8) promote collaboration among the faculties in the region.

The CMAAE program involves 20–24 months of study over a period of five semesters. Participating universities are responsible for teaching eight core courses to the enrolled postgraduate students. Courses include microeconomics, macroeconomics, production economics, econometrics, mathematics for economics, statistics, research methodology, and a course on agricultural economics issues. Universities in the network are accredited by the program based on specific criteria, including, for example, that they have at least five PhD-qualified faculty staff to teach core courses. As of 2011, the program had accredited seven universities: Lilongwe University of Agricultural Sciences (Malawi), the University of Zimbabwe, the University of Pretoria, the University of Nairobi, Makerere University in Uganda, Sokoine University in Tanzania, and Egerton University in Kenya.

The Achievements

CMAAE admitted 394 students in its first six years, from2005 to 2010 (Table 2).The first four cohorts of 155 students have graduated, with a graduation rate of 67 percent. As of 2011, 94 students were enrolled in the program's sixth cohort, of which 43 were female. As of October 2011, it was estimated that the total enrollment would be about 105 students per year.

Table 2. CMAAE student enrolment by nationality across six cohorts, 2005–10

	Yearly enrolment						
Nationality	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**
Ethiopia	–	–	–	–	4	3	7
Kenya	21	16	26	34	24	35	156
Malawi	1	4	2	15	5	18	45
Rwanda	–	–	2	3	4	7	16
South Africa	4	5	4	2	3	5	23
Tanzania	–	–	1	–	1	1	3
Uganda	16	8	7	2	5	11	49
Somalia	–	–	–	–	1	–	1
Mozambique	–	–	–	1	1	–	2
Sudan	–	–	–	1	–	–	1
Zambia	1	1	–	8	7	6	23
Swaziland	–	–	2	1	1	8	12
Zimbabwe	13	12	8	12	11	–	56
Yearly total	56	46	52	79	67	94	394

Source: CMAAE 2011.

The Cost

The cost per student for the two-year program is about US$24,000, which includes tuition, boarding and lodging, and thesis-related costs. This makes the program cost-effective compared with North American and European programs, but the cost is relatively high compared with the national programs in Africa, partly due to the expenditures involved in educating the student through the shared facility.

Special Features

Several supporting activities help the CMAAE program to engage with its network partners:

- The program strengthens the capacity of faculty members in the network's nonaccredited departments by providing competitive scholarships for PhD studies and by supporting six PhD students through a sandwich program in collaboration with Cornell University. The program also supports its alumni in being able to present their research findings in international forums.
- CMAAE supports faculty research through competitive research grants of about US$15,000, eight of which were awarded in 2011.
- Thesis dissemination workshops bring program graduates and the stakeholders of their research together to engage in discussion; four such workshops were held in 2011.
- The program became a part of the African Economic Research Consortium (AERC)—a network of African universities and research organizations conducting economic research and analysis—in April 2010 and therefore is able to share its publications and information through AERC's website, thereby facilitating ongoing engagement with stakeholders.
- In 2010, the program began an exchange program among its network partners, whereby faculty members are encouraged to spend up to one year on sabbatical at another faculty.
- Institutional support is provided through funding for the purchase/supplementation/replacement of equipment, resources, computer laboratories, and reference materials needed for the program.

Several factors contributed to the success of the program. First, it is demand-driven: the program began with an analysis of the needs for agricultural economics capacity in the region, which facilitated the

establishment of the curriculum and ensured that it met the skill sets needed by the employers in the region. Second, the quality and the relevance of the programs is high, reflected in the competitive selection of applicants; the self-sponsorship of applicants; and the sponsorship of applicants by governments, the private sector, and nongovernmental organization (NGOs). Third, the program has secured continuous buy-in from donors, and donor bases remain diversified. Finally, the program is cost-effective compared with those offered by the European and North American Universities.

The Program Challenges

Although the program has been successful in meeting its objectives and continues to be well-implemented, it faces several challenges.

First, the program has a completion rate of less than 70 percent, which is less than was anticipated by the program's designers. While some level of attrition is expected in any higher education program, the current level of noncompletion largely stems from the poor support of candidates by their home institutions in finishing their theses. Some supervisors delay the correction of the thesis. Some students also take a break after the course work and can lose the necessary momentum for completion. In efforts to address this challenge, the program has instituted an award of US$500 for graduates who complete their thesis on time.

Second, the comparatively high cost of the CMAAE program deters self-sponsored students. Despite being competitive compared with programs at European and North American universities, the program's cost is still high by African standards. The yearly cost of an MSc degree in applied economics and management at Cornell University, for example, is roughly US$20,000 for tuition alone, whereas the yearly cost of at the University of Pretoria is about US$9,000 for both tuition and accommodation. Third, the program continues to depend on external donors, but they would like the program to become self-sustaining in the next few years. Fourth, the participating departments have different program cycles depending on their country contexts, so harmonizing admission calendars across participating departments has been difficult. Fifth, the program offers eight core courses and 20 electives; however, the demand for some electives is so low that they are not regularly offered, making critical mass a necessity if these electives are to become viable. Finally, sustaining the shared facility where students come together to take specialized courses will be costly long term. Nevertheless, the shared facility is the cornerstone of the program and accounts about 50 percent of its cost. In the future this share could be reduced as the program moves toward the use of e-learning methods.

CMAAE is currently funded by the African Capacity Building Foundation and the Bill and Melinda Gates Foundation. In addition, the German Academic Exchange Service (DAAD), the Economic Research Service (ERS) of the United States Department of Agriculture (USDA), and the Centre for Development Research (ZEF) of the University of Bonn provide targeted support to fund scholarships for students.

Strengthening Capacity for Agricultural Research in Development in Africa[4]

Background

The capacity strengthening programs implemented in Africa have been criticized for being supply-driven without adequate consultation with the local institutions that implement the program. In order to shift this situation, the Forum for Agricultural Research in Africa (FARA) initiated a new program: Strengthening the Capacity of Agricultural Research and Development in Africa (SCARDA), which was implemented in March 2008 (FARA 2007).The shift was also needed from a piecemeal approach to solving capacity problems, to strategically strengthening entire institutions. In addition to learning-by-doing approaches, SCARDA emphasizes reflecting on lessons learned and improving processes. Institutional analysis is conducted through a participatory process to identify gaps and build ownership among participating institutions. Once gaps have been identified, tailor-made capacity strengthening packages are developed as part of the action plans for organizational change

[4] This section is drawn from SCARDA's annual reports and several program documents.

management that ensure that capacity strengthening actions are embedded in change management processes at the organizational level. Some elements of the capacity strengthening package include combinations of short-term professional training in specific technical areas, research management, monitoring and evaluation, agricultural information and communication management, and long-term postgraduate training.

The Approach

The SCARDA approach to capacity strengthening for agricultural research for development emerged from several stakeholder consultations. It features

- a holistic approach to strengthening capacity, focusing mainly on a limited number of willing institutions from a cross-section of countries;
- building on existing strengths within subregions in the identification and contracting of capacity strengthening service providers;
- a demand-driven and participatory approach, identifying challenges, fostering an understanding and commitment to addressing these challenges, and agreeing to set priorities through institutional analysis;
- using less "traditional" methods to address capacity strengthening priorities (for example, mentoring, participatory institutional analysis, tailor-made courses, and participant action plans);
- integrating gender and other cross-cutting social inclusion issues into the planning and implementation of capacity strengthening activities;
- learning from the lessons of past capacity strengthening initiatives; and
- complementing existing and planned initiatives of the participating member organizations.

The SCARDA approach is a facilitated process of strengthening whole organizations to bring about institutional change through the development and implementation of targeted and tailor-made capacity strengthening packages. The program's validation phase focused on 12 NARIs and universities in SSA, referred to as focal institutions. The SCARDA approach also allows for mentoring support at individual and organizational levels to address local and national priority gaps for capacity strengthening. Platforms are established for lesson learning at national, subregional, and regional levels. These platforms facilitate lessons on organizational and management changes and on regional spillovers in implementing innovative programs and policies for capacity strengthening.

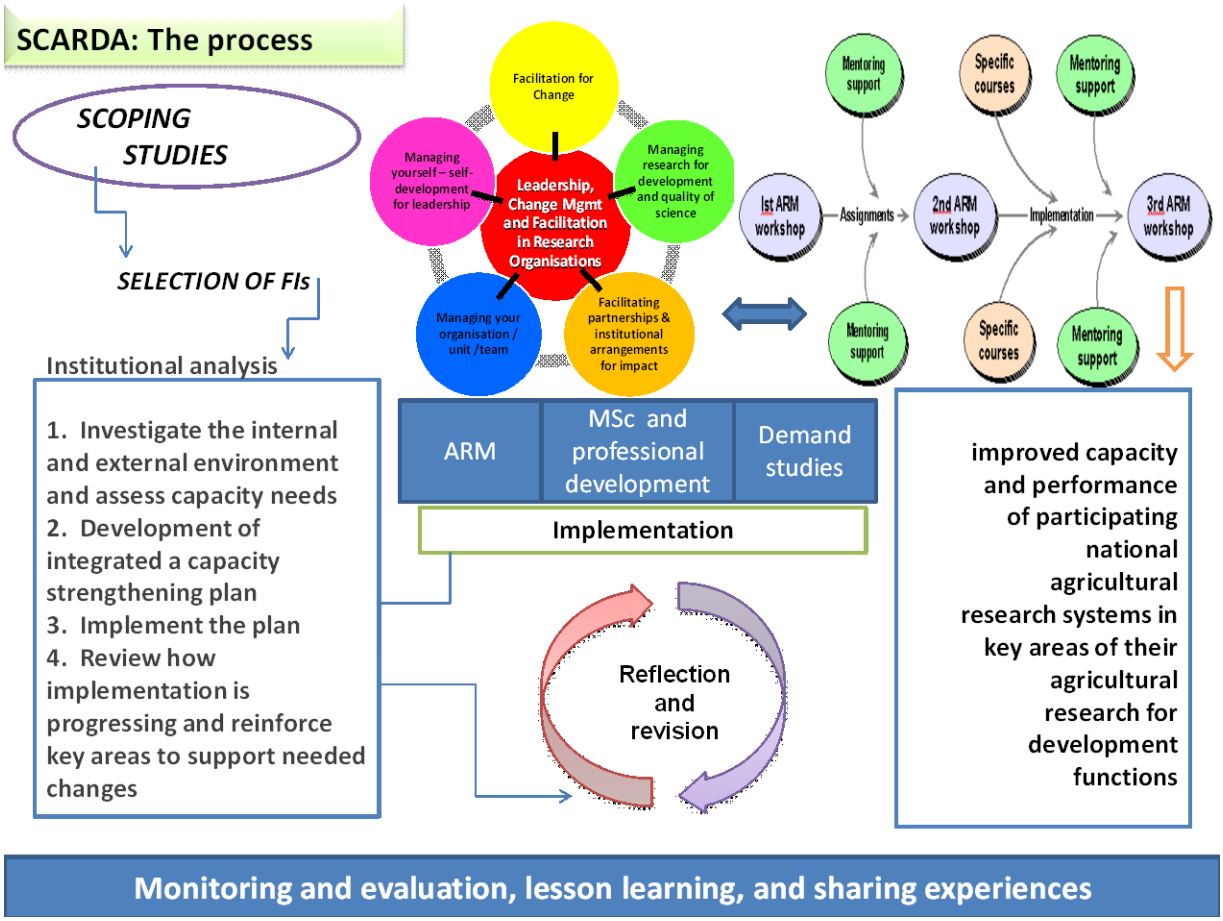
In this way, SCARDA endeavors to improve the functioning of agricultural research systems and specific demand-driven competencies in participating countries. NARIs and universities not only have better knowledge, but are also connected with national agricultural innovation systems. In addition, SCARDA aims to achieve improved capacities for NARI scientists, researchers, and extension agents who transfer the technology to the farmers working with knowledge intermediaries. This paper, however, focuses on the nine national research organizations participating in SCARDA.

Program Design and Process

The SCARDA process of institutional analysis, capacity strengthening implementation, and reflection and revision is illustrated in Figure 1.The process began with scoping studies to identify focal institutions, which were then analyzed as a means of developing an integrated capacity strengthening plan. Implementation of the plan involved capacity strengthening through short-term and MSc-level courses. Based on demand, determined through needs assessment studies, the following training modules were developed and offered:

1. MSc-level training in areas where the focal institutions were lacking capacity;
2. research management training courses; and
3. short professional courses to upgrade skills (such as proposal writing, integrated pest management, and participatory farmer research) to improve the abilities of researchers and technicians.

Figure 1. The SCARDA process of capacity strengthening during the validation phase



Source: FARA 2010.
Notes: FIs indicates focal institutions; ARM indicates agricultural research management.

SCARDA employed two additional strategies to ensure effective use of the capacity and skills gained by the participants of the training programs:

1. a mentorship scheme for the MSc students and other trainees who were mentored after the training events to help them achieve specific goals based on their newly acquired skills and knowledge; and
2. development of action plans for organizational change management formulated by the management trainees in consultation with the management of their respective focal institutions to improve the overall performance of the organization.

SCARDA is coordinated by the FARA Secretariat and is implemented in accordance with the "subsidiarity principle"[5] by the subregional organizations (SROs). Participating focal institutions included the following.

1. In the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) countries: Institut des Sciences Agronomiques du Rwanda (ISAR, Rwanda), Institut des Sciences Agronomiques de Burundi (ISABU, Burundi), and Agricultural Research Corporation (ARC, Sudan).

[5] The subsidiarity principle states that no activity should be undertaken by the centralized authority that can be handled competently by a decentralized institution.

2. In the West and Central African Council for Agricultural Research and Development (CORAF/WECARD) countries: Crops Research Institute (CRI, Ghana), Centre de Recherches Agronomiques de Loudima (CRAL, Congo), Institut d'Economie Rurale (IER, Mali), and National Agricultural Research Institute (NARI, Gambia).
3. In Southern African Development Community (SADC) countries: Botswana College of Agriculture (BCA, Botswana), Department of Agricultural Research (DAR, Botswana), University of Zambia (UNZA, Zambia), National University of Lesotho (NUL, Lesotho), and Natural Resources Development College (NRDC, Zambia).

The program also enlisted a number of service providers to facilitate in various aspects of implementation, and lead service providers including RUFORUM, the African Network for Agro-Forestry and Natural Resources Education (ANAFE), Centre Regional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle (AGRHYMET), and the Natural Resources Institute (NRI) of the University of Greenwich in the United Kingdom, which played an active backstopping role. The validation phase was funded by the U.K. Department for International Development (DFID).

Achievements

Four major outputs of SCARDA were envisioned:

1. *Strengthening the capacity of agricultural research management systems and managerial competencies to conduct high-quality research in participating NARSs.* All participating focal institutions developed capacity strengthening plans, benefited from training in agricultural research management, prepared action plans for organizational change management, and engaged in organizational mentoring. Several training courses in strategic planning, monitoring and evaluation, innovative systems approaches, and writing research proposals were implemented for staff of focal institutions. Over 100 managers participated in the employee mentoring programs.
2. *Strengthening the capacity of participating NARSs to undertake high-quality agricultural research for development.* A total of 78 staff of focal institutions from Africa's three subregions undertook MSc training in specialized disciplines. Nearly all of them have been awarded their degrees and have returned to their sponsoring organizations. Several short courses on participatory farmer research, innovation systems approaches, integrated pest management, monitoring and evaluation, and research management were also offered.
3. *Establishment of relevant training programs in agricultural universities to meet current market demand*. Assessments of the evolving employment opportunities for agricultural graduates were conducted in all three subregions. In the CORAF/WECARD subregions, demand studies focused on Congo, Ghana, Gambia, and Mali; in the ASARECA subregions, studies were conducted in Kenya, Ethiopia, Malawi, Mozambique, and Tanzania; and in the SADC subregion, studies were conducted in Botswana, Lesotho, and Swaziland. The studies showed that many of the universities in Eastern and Southern Africa have a remarkably stable and well-qualified staff, and that the universities can provide the leadership and guidance necessary to garner the resources essential to changing the agricultural sectors. The studies confirmed that a major weakness was the poor image of agriculture among many potential students.
4. *The SCARDA approach to capacity strengthening is validated.* The SCARDA approach has been endorsed by all stakeholders through several workshops and meetings, and feedback indicates that the program has helped to make significant changes in the functioning and the interactions among the research institutions. Currently, SCARDA provides the basis for the CORAF/WECARD strategy for capacity strengthening and knowledge management, and ASARECA is in the preparatory phase of out-scaling the SCARDA approach in six countries.

The feedback from the implementing partners indicated that the SCARDA approach has been beneficial in stimulating reform efforts at the national and organizational levels. It is highly relevant for addressing crucial bottlenecks in their organizations and offers the right mix of capacity strengthening instruments. Furthermore, the SCARDA approach ensures actual use of newly acquired knowledge and skills by the trainees through the mentoring scheme. In addition, SCARDA has raised awareness of research management issues and challenges, and has upgraded the skills of the participants to enable them to tackle these challenges. Finally, a structured and better informed process has promoted the engagement of research stakeholders in addressing the agricultural research management issues of the focal institutions.

Implementation Challenges

Implementation of SCARDA has faced several challenges in addition to the complexities of working across so many countries and with such a wide range of stakeholders. The main challenges include (1) an overly ambitious project design, especially with regard to expectations of what can be achieved within the project's timeframe, (2) the extensive time required to formalize the working relationships between FARA, the SROs and the lead service providers, (3) full adoption of the subsidiarity principle, (4) the unpredictable nature of funding, and (5) inadequate monitoring and evaluation.

4. LESSONS FROM CAPACITY STRENGTHENING APPROACHES

Several lessons emerge from the contemporary approaches described above. In the context of the core principles of capacity strengthening, all three programs fare well with varying degrees of success. In the process of building long-term capacity, it is important to account for capacity gaps and correct them through appropriate methods of management, maintenance, and use of existing capacities, accompanied by proper incentives and institutional changes. While creating capacity for agricultural research is inherently a long-term process because it involves research-oriented higher education and training. In the short-term, created capacity can be lost if it is not effectively used and offered appropriate incentives. To ensure effective use of capacity, strategic capacity needs to be identified, and competition needs to be nurtured within each country. The SCARDA approach to building institutional capacity among the NARIs is a promising approach in this context requiring further analysis for support.

In building capacity for agricultural research and innovation in Africa current capacity challenges need to be viewed within the broader agricultural development context. For example, the CAADP process requires that countries aim to allocate 10 percent of their national budgets to agriculture and work toward achieving 6 percent agricultural growth per year. While countries are currently developing strategy papers under CAADP, several success factors can contribute to agricultural development. It is not always necessary that the technologies be developed by local researchers and innovators; numerous technologies can be borrowed and adapted locally. Capacity for such local adaptation, however, is currently lacking, and it is important that capacity is built quickly to translate existing knowledge and technologies currently used in similar agroecological systems. A major challenge for such adaptive research is the large amount of heterogeneity in local cropping systems. Despite this, large areas of maize are cultivated by smallholders in Eastern and Southern Africa, and the same can be said for rice cultivation in several West African countries. These areas could be considered homogenous zones for cultivating single commodities across larger areas. While this gives an opportunity to combine the efforts of agricultural research from several countries and to conduct regional research programs, the capacity to adapt the research outputs for national use needs to be identified and recognized. In addition, institutional support for the adoption of such technologies at the regional level requires capacity to analyze the supporting policies, such as seed, marketing, and trade policies, as well as institutional strengthening to implement such policies. The ACCI program is an example of how home grown capacity could enhance the skills immediately needed, while at the same time generating solutions to long-term agricultural development problems.

The ACCI program shows how locally designed capacity development programs could reduce the problem of brain drain, which has long stifled African agricultural development. It also shows how local capacity development programs can address current research challenges on African crops. Program participants used local resources and methods. The program has also shown that time can be gained by participants remaining in contact with their home institutions and completing their theses research as part of their regular employment. In addition to agricultural research capacity, the adaptive approach to technology generation will require effective use of extension and advisory services, along with the capacity to import and distribute fertilizers and chemicals needed for agricultural production. Thus, in addition to research and innovation capacity, a range of complementary capacities will be needed at the country level.

The CMAAE program builds these complementary capacities by amalgamating existing teaching capacities in the region, making it possible to provide high-quality teaching and research program to strengthen both individual and institutional capacities. The CMAAE program also shows that it is possible to mobilize local talent to build regional capacities, while gradually strengthening local faculties. This program did not rely on the center of excellence approach but instead involved 16 departments collaborating and offering their own expertise to achieve a regionwide goal. Because the CMAAE program focused on a single discipline, it was able to populate the profession in a short period of time.

SCARDA's contribution toward building agricultural research management capacity through the subsidiarity principle has shown that, by imparting management skills and providing mentoring, both individual and institutional capacity can be strengthened. The SCARDA approach shows that on the job training and mentoring can help institutions to retain staff and increase their productivity. Nevertheless, all these programs heavily depend on external funding. As the African countries grow, these programs will need to become a regular part of existing research and educational institutions in participating countries, and this should be the objective of the programs moving forward.

Table 3 shows various capacity development process indicators for the three programs. All three have performed well in contextualizing capacity development through their demand driven process of identifying capacity needs. They bring together participants from different countries to facilitate mutual learning and knowledge sharing. Will the backup of external technical assistance they have been able to adopt best global standards. And while all three programs aim to develop institutional capacities, all three are dependent on external funding, which makes the sustainability of the programs a major concern in the long run.

Table 3. Selected indicators of capacity development in the context of CAADP process

Selected process indicators	African Center for Crop Improvement (ACCI)	Collaborative Masters Program in Agricultural and Applied Economics (CMAAE)	Strengthening Capacity for Agricultural Research in Development in Africa (SCARDA)
Demand driven	The program was developed as a result of high need expressed by the African agricultural research community	The program emerged from several levels of regional consultations	The program is a result an expressed need from stakeholders of FARA through various consultations.
Needs assessment	The needs assessment revealed the critical need for breeders who could conduct adaptive research on various African crops.	Needs assessment revealed the strengths and weaknesses of various faculties and how to bring existing capacities together to generate high-quality capacity	The needs assessment indicated the importance of subsidiarity principles and for strengthening institutional capacity in addition to individual capacity.
Capacity delivery mechanism	Combined both the teaching and rigorous training by the University of Kwazulu-Natal and the practical training through mentors in the local institutions. This helps to address local problems and made the capacity develop highly relevant for the participants' country.	Effectively used the African capacity although additional external support was sought to fill the gaps in teaching. The shared facility approach was efficient in increasing the quality of the program jointly.	SCARDA's approach to capacity development focused on strengthening the whole organization giving emphasis on filling the gaps in the skills of the individuals. This is in line with the CAADP process needs for capacity development.
Contextualization of the capacity for local needs	ACCI participants applied their knowledge to solving problems in their own countries.	While the theoretical training was common to all graduates in the applied areas of the program, the participants applied their skills to address socioeconomic problems in their countries	Capacity developed under SCARDA was intended to directly influence the organization and management of the research organizations. This contextualized approach helped to focus individual attention on the participating organizations.
Ensuring use of capacity by local organizations	The participants came from the research institutions in various countries who returned to their jobs to conduct their thesis research; thus the capacity developed was used effectively by host institutions.	While the capacity developed is of high quality, due to high demand for the applied economics capacity, graduates have found placements that contribute to the agricultural development process in their countries.	SCARDA strengthened existing capacity without adverse effects in terms of attrition.
Mutual learning and sharing of knowledge	Sharing of knowledge on problems and solutions was facilitated by bringing students to Kwazulu-Natal to train in plant-breeding methods.	The shared facility approach brought students from various participating countries together to achieve specific learning goals. This facilitated mutual learning among participants.	SCARDA programs provided adequate opportunities for mutual learning.
Funding and sustainability	The program depends on donor funding to support the participation of the international students.	The program continues to depend on external sources of funding, although several self- and government-sponsored students have recently been accepted into the program.	Uncertainty in funding and the dependency on external resources for program implementation remain challenges for long-term planning.

Source: Compiled by authors.

5. CONCLUDING REMARKS

While the three programs reviewed in this paper emphasize local production of capacities through building local institutions, they continue to depend on external sources of funding. The recent economic growth in several African countries could help such programs to become self-sustaining, but funding from the participating governments, particularly in the context of CAADP implementation, will be necessary. Further recent developments in terms of organizing global approaches to capacity development for agricultural research and innovation—such as modifications to the Consultative Group for International Agricultural Research (CGIAR) and the Capacities Montpelier Action Plan (CAPMAP 2010–20)—also call for the overhaul of capacity building approaches for international agricultural research for development. The Montpelier initiative emphasizes "building the capacity to build capacity." This program is likely to support the development of regional centers of excellence in training for agricultural research and development in each of Africa's subregions. In order to take advantage of the emerging interest in capacity strengthening, it is important that NARSs prepare by identifying their strategic capacity and institutional strengthening needs, as well as providing overall leadership to enable the successful use of the capacities developed. While further innovations are needed to strengthen capacities cost-effectively, the three programs reviewed emphasize the role of national leadership. Agricultural research plans for capacity strengthening offer a forum for discussion to ensure that capacity strengthening remains high on the agricultural development agenda.

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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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