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# NETWORK INNOVATIONS

## Building the Next Generation of Agricultural Scientists in Africa

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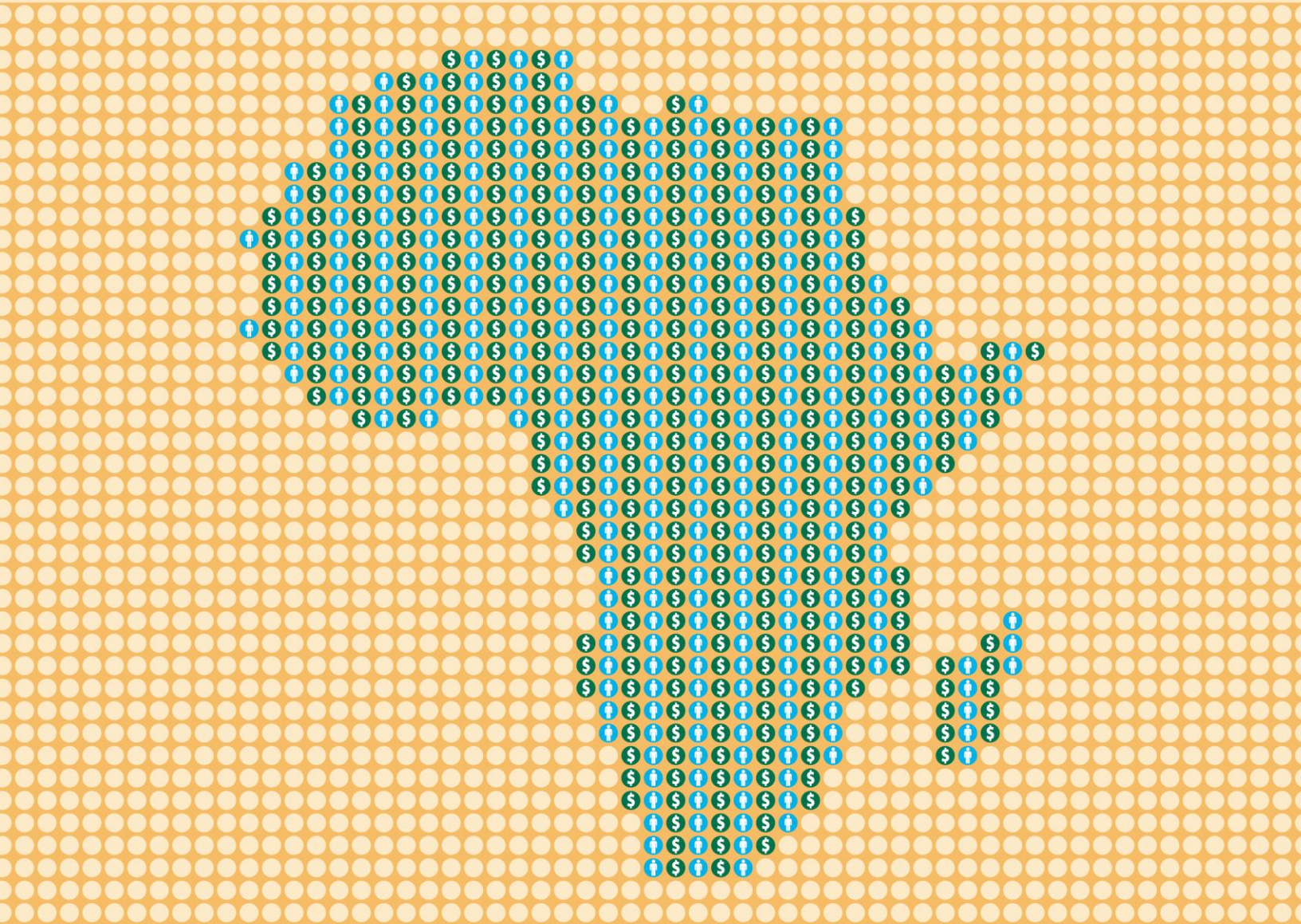
AGRICULTURAL R&D: INVESTING IN AFRICA'S FUTURE
Analyzing Trends, Challenges, and Opportunities



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## Acronyms and Abbreviations

| | |
|---|---|
| AERC | African Economic Research Consortium |
| APHRC | African Population and Health Research Center |
| AGRA | Alliance for a Green Revolution in Africa |
| ANAFE | African Network for Agriculture, Agroforestry and Natural Resources |
| AU | African Union |
| BASIC | Building African Scientific and Institutional Capacity |
| BecA | Biosciences Eastern and Central Africa |
| CAADP | Comprehensive Africa Agriculture Development Program |
| CARTA | Consortium for Advanced Research Training in Africa |
| CGIAR | Consultative Group on International Agricultural Research |
| CMAAE | Collaborative Master of Science in Agriculture and Applied Economics |
| EACI | Education for African Crop Improvement |
| FARA | Forum for Agricultural Research in Africa |
| ICRAF | World Agroforestry Centre |
| NARS(s) | national agricultural research system(s) |
| NEPAD | New Partnership for Africa's Development |
| NGO(s) | nongovernmental organization(s) |
| RUFORUM | Regional Universities Forum for Capacity Building in Agriculture |

## Abstract

Despite several decades of crises in agricultural higher education, there has been major improvement. Many universities and research institutes in Africa are abandoning outmoded ways of doing things and devising new structures, behaviors, and incentives. Yet these advances are often inadequate to produce a new generation of scientists and leaders with the knowledge and skills to replace the large numbers in the agricultural sector now close to retirement, and spur the agricultural growth needed to reduce poverty. One increasingly popular way of building a strong human capital development infrastructure and harnessing gains from innovation in the research process is investment in networks. Networks, for the purposes of this discussion, refer to postgraduate training and collaborations that strengthen institutions, unimpeded by geography—such as a collection of agricultural scientists capitalizing on greatly improved mobility and telecommunications to transcend institutional and national boundaries. This paper identifies five models of strategic networks making progress toward the stated goals of bolstering university-based training and research, and enhancing the productivity of the agricultural sector. These models, while different in their composition, offer key principles and approaches of networks that are scalable and have the potential to be sustained. Of particular importance are those with the ability to produce "scientist entrepreneurs," create professional career structures, ensure gender equity, build economies of scale and serve as leverage points for translating knowledge into innovation and application.

## 1. INTRODUCTION

The past two decades have ushered in one of the most colossal revolutions of knowledge and information in human history. Digital information and communications technologies have transformed the manner in which knowledge and technical know-how move around the world. Genetics and biotechnology are bringing about a new epoch of innovation in the sciences. And the emergence of new finance and investment models, like social enterprise and venture capital, has helped turn knowledge into both great wealth creation and a widening wealth divide. In the agricultural sector, recent advances in biotechnology—such as breeding of higher yielding and better adapted crop varieties, along with market-friendly policies and improved national research institutions—are helping to create a new platform for progress in Sub-Saharan Africa. Strengthened commodity value chains that boost productivity, coupled with new forms of collective action and seismic change in farmer accessibility to low-cost information technologies offer exciting opportunities to use agriculture to promote development.

In the face of this proliferation of new knowledge and science breakthroughs, the volume has been turned up on calls from African governments, the international funding community, and African scientists alike for a response to the challenges facing resource poor institutions in building research and development capacity. An abundance of relatively recent essays and reports—perhaps best typified by the catalytic 2008 *World Development Report*[1] and by Calestous Juma's book, *The New Harvest: Agricultural Innovation in Africa* (Juma 2011)—argue that most needed is a transformation that will connect the mission and vision of advanced learning institutions with new local and global contexts. University-derived research is now commonly touted as essential to agricultural performance, from rapid appraisal of delivery services, marketing, and policy to strategic research aimed at the creation and testing of new products appropriate to the African environment.

No doubt that, despite the past two or three decades of crises in higher education, there has been major improvement. Many universities and research institutes are abandoning outmoded ways of doing things and devising new structures, behaviors, and incentives. Especially important are initiatives that advance the process of knowledge production and application and encourage fresh thinking about building agricultural systems that adjust to change. Yet these gains are often inadequate to produce a new generation of scientists and leaders with the knowledge and skills to replace the large numbers in the agricultural sector now close to retirement, and spur the agricultural growth needed to reduce poverty.[2] At the MSc and PhD training levels especially, where staffing and other resource constraints are most severely felt, individual universities are hard pressed to generate a critical mass of graduates with the requisite qualifications to catalyze social and economic progress.

One increasingly popular way of building a strong human capital development infrastructure and harnessing gains from innovation in the research process is investment in networks. By networks, for the purposes of this discussion, we refer to postgraduate training *and* collaborations that strengthen institutions, unimpeded by geography—such as a collection of agricultural scientists capitalizing on greatly improved mobility and telecommunications to transcend institutional and national boundaries. But while a number of such agricultural networks now exist on the continent, most have a scale or scope

[1] By providing evidence that increasing agricultural productivity is three times more effective at reducing poverty in poor countries than growth in non-agricultural productivity, the 2008 *World Development Report* (World Bank 2007a) helped to make agriculture once again a high priority for African governments and the international development community.

[2] Support for formal agricultural education averaged 1.6 percent of national budgets in Africa during 1995–99 but declined to 0.7 percent between 2000 and 2004. In 2008, 30 percent of agricultural researchers employed in 32 African countries held a PhD degree, and 43 percent were qualified to the MSc level. A major concern in many countries is the rapid aging of this pool of scientists, many of whom will approach retirement age within the next decade (Beintema and Stads 2011). Also see Beintema and Stads (2011) for information on long-term trends in human resource capacity in agricultural R&D in Sub-Saharan Africa, especially during 2000–08.

of operation too small and poorly resourced to realize their potential for creativity and innovation (Fine 2007a).

This paper identifies five models of strategic networks making progress toward the stated goals of bolstering university-based training and research, and enhancing the productivity of the agricultural sector. These models, while different in their composition, offer key principles and approaches of networks that are scalable and have the potential to be sustained.[3] Each has a base secretariat or management group within a host institution that provides coordination and technical assistance, and promotes the use of low-cost (and in some cases, more advanced) information technologies. Each network is primarily based on one or more disciplinary fields but offers an array of subject matter that encourages systems thinking. Each network provides professional career structures necessary to develop a stable cadre of African research leaders, and each creates network services that build economics of scale. These networks are fortified by linkages to local stakeholders (for example, the private sector, nongovernmental organizations [NGOs], and government bodies) to continental alliances (for example, the African Union (AU), Forum for Agricultural Research in Africa (FARA), Comprehensive Africa Agriculture Development Program (CAADP) under the auspices of the New Partnership for Africa's Development (NEPAD) and to global agricultural entities (for example, the CGIAR, world-class universities outside the region, international markets).

## 2. BACKGROUND ISSUES

The network concept offers great appeal as a vehicle for fostering advanced knowledge and knowledge applications, and for extending limited resources. It creates enduring institutional relationships based on a common mission and standard of effectiveness and relevance that can attract the attention of African governments, the private sector, and external funders.[4]

The focus on training and research networks springs from broad shifts in world forces that affect higher education everywhere. These include:

- the unfolding of the knowledge economy, which places a premium on intellectual capital as reflected in boundary-crossing disciples that few universities can properly cover;
- the drive by funders of advanced learning—governments, donors, and students and their families—to unite knowledge with practical skill employment;
- less expensive, more obtainable bandwidth that can exploit new modes of communicating information in various electronic formats;
- burgeoning private investment in higher education resulting in a free range of education providers and growing public concern about quality control issues;
- world trade in education services, including the flow of faculty and advanced graduate students across national borders that if not resulting in permanent brain drain can still cause periodic gaps in quality staffing; and

[3] This paper draws on many of the insights offered by Jeffrey C. Fine and Peter Szyazlo in a 2006 study (Fine 2007a) commissioned by the Partnership for Higher Education in Africa (an alliance of seven U.S. foundations) on regional networks engaged in research and postgraduate education on the continent. The database of 120 networks developed for the study can be found on the Partnership website: www.foundation-partnership.org.

[4] Several agricultural networks in various parts of the world, such as the Asian Rice Biology Network, were created to reinforce already strong institutional research or service delivery structures, and extend their impact. However, the majority of networks in Africa have evolved as compensatory mechanisms for fragile, neglected institutions and structural defects in national systems of agricultural research and higher education. They are designed to ensure depth of analysis and critical mass within strategic research fields that would otherwise be extremely difficult and costly to achieve on a country-by-country basis (Moock 2005).

- increasing "knowledge prospecting" (identifying new technologies and using them to create new businesses) across academia, government, and the private sector that offer universities an opportunity to step-up their role in shaping Africa's future (Juma 2011).

Within Africa, reasons to invest in cross-institutional networks are especially compelling:

- generating economies of scale among research universities that are small and unable to attain the necessary expertise, equipment, and financial resources to cover core and specialized courses in most postgraduate agricultural fields;
- building of credibility and legitimacy for African governments and donors in demonstrating solid academic programs that engage with other stakeholders in the agriculture sector and produce employable graduates;
- exploiting both the lessened rigidity of faculties under more democratized and decentralized university management, and complementarities and synergies in innovation;
- promoting quality assurance through interaction, information sharing, and peer review;
- strengthening links between academic research centers and the (re-)emerging private sector;
- building a critical mass of female scientists in the face of the narrow pipeline of female students surfacing from undergraduate studies at individual universities[5]; and
- harnessing movements toward regional integration that present opportunities for reducing costs of research and training,[6] avoiding duplication, and simultaneously providing safety nets in the event of political strife in any one geographic site.

Similar reasons have led to recent calls for large-scale investment in "centers of excellence," which are also intended to build economies of scale in producing qualified staffing and facilities. Such initiatives can be attractive to funders as they hold the promise of sidestepping the high transaction costs of bringing together different actors and institutions with diverse capacities; but there is a major downside to the creation of these *insulated* regional entities. As Jeffrey Fine points out, "Past experience . . . dictates that the lack of a genuine buy-in by national institutions, in particular leading universities, will prove fatal. Once external funding disappears, local support also evaporates. Unless these collaborative efforts complement rather than substitute for investment in national systems of higher education and research, they will also fail" (Fine 2007b).

In contrast, well-designed institutional collaborations can have a longer shelf life.[7] If the primary need in producing the next generation of agricultural scientists is a rapid increase in numbers, then networks and insulated centers of excellence can be equally powerful, with the advantage perhaps going to the more easily managed, unencumbered centers. However, solid network approaches—especially those backed by world-class overseas universities or high-quality local institutions serving as regional postgraduate program hubs—may have the edge in the long-run in attracting funding from African governments on the basis of unlocking innovation customized to the dynamics of the national

[5] According to Beintema and Di Marcantonio (2010), in 2007 an average of one-third of the students enrolled in and graduating from 28 higher education faculties or colleges in a sample of 12 Sub-Saharan African countries was female.

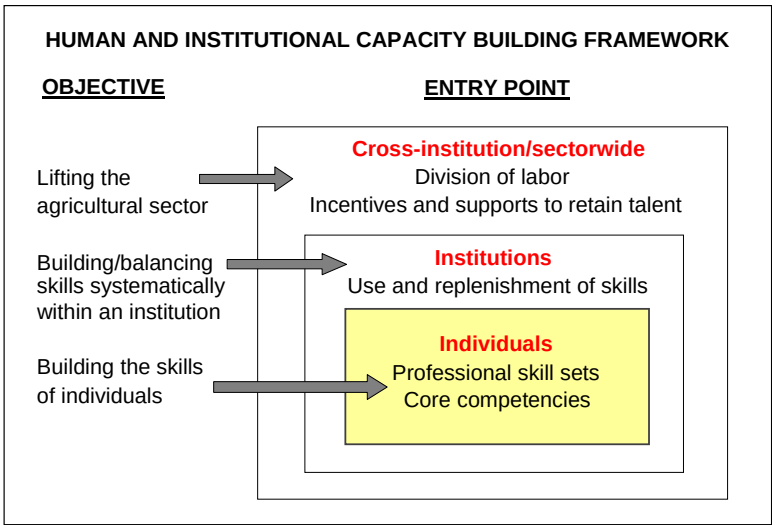
[6] In 2006, estimated total costs of a two-year MSc degree in agricultural economics at a U.S. university with a fellowship from the United States Agency for International Development was $60,000, while a U.S. sandwich course with thesis research in Africa was $30,000, and a degree program offered by the Collaborative Master of Science in Agriculture and Applied Economics (CMAAE) was $20,000 (Eicher 2006).

[7] Carl Eicher argues that "Regional models of agricultural training and research were productive during the colonial period and the early years of Africa's independence. But development specialists have few answers to the difficult problem of financing regional organizations and regional centers of excellence. The wave of the future should be to encourage regional knowledge networks and regional training programs and increase the use of ICT" (Eicher 2009: 252).

environment.[8] In this regard, perhaps the greatest attraction of networks is their ability to serve as leverage points for restructuring domains of training and research to relate more significantly to complex social and economic dynamics.

The most promising networks for agricultural development are based on a notion of capacity building that is undergoing enormous change. This involves consideration of a much broader range of influences and consequences than were included in traditional definitions. In the context of competitive and knowledge-intensive agricultural economies, capacity building must refer to more than technical training and transfer of skills. While these are necessary, they are not sufficient for fostering capacity that can be well utilized, retained, and replenished. A more systemic definition of capacity building would include, *in addition to technical skills transfer:* institution strengthening, the improvement of inter- or intra-organizational structures, and the imparting of entrepreneurial competencies and business acumen necessary to develop vision and strategies (Figure 1). Thus, the emphasis must be on doing and accomplishing, not just on training and learning. This extended definition enables a program to be assessed based on whether its design is adequate to produce the desired outcome.

**Figure 1. Three dimensions of entrepreneurial capacity**



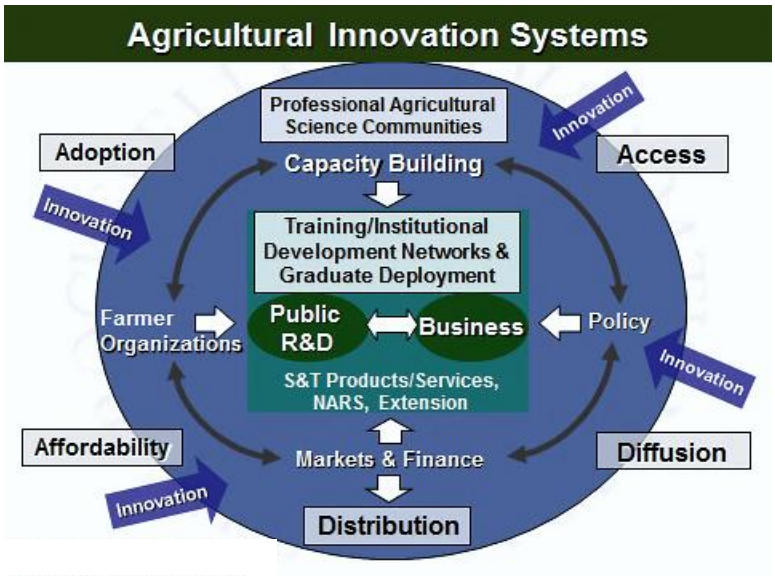

Source: Devised by author.

Sustained capacity-building in Africa today requires flexible, low-cost approaches that (1) spark not only conventional skills, but also improvisational, experimental, management, and leadership talents; (2) strengthen universities and provide transition mechanisms, such as mentoring and apprenticeships, for graduates to access opportunities for meaningful work; (3) offer effective utilization of skills through alignment of the various components of the agricultural system and chances for joint action; and (4) promote retention by professional community development, network-based knowledge dissemination, incentives, and output rewards.

[8] Such hubs might be hosted by universities or research institutes with strength in narrowly specialized or newly emerging areas (for example, the Dryland Resource Management regional PhD program, University of Nairobi; the Aquaculture and Fisheries Science program, Bunda College, University of Malawi; the MSc Research Methods course at Jomo Kenyatta University of Agriculture and Technology, Kenya; the Soil and Water Management regional PhD program, Sokoine University, Tanzania; or the Biosciences eastern and central Africa (BecA) at the International Livestock Research Institute, Kenya.) These differ from insulated centers of excellence. Although resources are concentrated on these subregional catchment centers, all university members benefit from institution-strengthening grants, scholarships, curriculum development, and participation in research supervision and teaching. Under the auspices of the AU, the Pan-African University is now in the midst of establishing five thematic centers of excellence on the continent. If each of these are eventually linked to 10 existing African institutions, as planned, the resulting regional networks might achieve sustained political backing, reliable financial resources, and—most importantly—credible grassroots support.

While professionalism is critical, skilled individuals cannot produce public goods in a vacuum. Attention needs to be given to quality training, the development of institutions, intelligent policymaking, and well-functioning national agricultural systems. Africa's next generation of agricultural scientists will need to be *scientist entrepreneurs—technologically* sophisticated people capable of bold thinking with a primary question in mind: how can *high*-impact innovations be adapted to the growth of agriculture with a view to poverty alleviation and environmental sustainability. The next generation will need to join the ranks of sharp, savvy entrepreneurs who are emerging across the span of African enterprise. They are the catalysts of change, conceiving new products and services and means to produce, market, and appraise them. Another way of looking at the role of postgraduate education systems and networks within the essential elements of a national agricultural innovation system can be depicted through the linkages among the various components, and the agencies and policies that make up the enabling environment in which they function (Figure 2).[9]

**Figure 2. Capacity building for scientists as a critical part of an agricultural system**




Source: Adapted from Morel et al. (2005).

This complex system of diverse actors and their interactions has enormous implications for higher education reform, especially in unleashing talent and innovation, and integrating educators and researchers into professional networks with other agricultural system agents (Spielman et al. 2008). In Africa there is need to both increase the supply of quality graduates and ensure that demand is also increased for their services through a supportive environment for agricultural enterprise at all levels (Blackie et al. 2010).

Faculties of agriculture certainly cannot be held accountable for all of these components, but they can set up the essential learning platforms to accommodate continued learning and high performance following graduation. This is the nexus between research and practice or policy that some of the more dynamic networks are reaching for. To achieve these ends requires thinking differently about institutional arrangements and reconsidering not only the creation of economies of scale, but also how advanced learning centers can serve as pivotal supports in local knowledge and innovation systems.

[9] "In essence, an agricultural innovation system is a blending of institutional capacities, coordination mechanisms, communications networks, and policy incentives that fosters innovation-led gains in agricultural productivity"(World Bank 2007b: 6).

The following section explores the key characteristics of five leading agricultural capacity-building research networks in Africa.[10] There are several others, but these standout in terms of their scale, scope, and potential for replication and sustainability.

**1. Regional Universities Forum for Capacity Building in Agriculture (RUFORUM)**

| | |
|---|---|
| Status | Nongovernmental organization |
| Secretariat location | Makerere University Campus, Uganda |
| Coverage | 29 universities in 15 East, Central and Southern Africa countries |
| Internet address | www.ruforum.org |

**2. Collaborative MSc Program in Agriculture and Applied Economics (CMAAE)**

| | |
|---|---|
| Status | Program of the African Economic Research Consortium (AERC), an NGO |
| Secretariat location | AERC, Kenya |
| Coverage | 18 universities in 12 East and Southern African countries |
| Internet address | www.aercafrica.org |

**3. Education for African Crop Improvement (EACI)**

| | |
|---|---|
| Status | Program of the Alliance for a Green Revolution in Africa (AGRA) |
| Central management location | AGRA, Kenya |
| Coverage | 10 MSc universities and 2 PhD training centers at the University of Ghana (West African Center for Crop Improvement) and the University of Kwa-Zulu Natal (African Center for Crop Improvement) serving 13 countries |
| Internet address | www.agra-alliance.org |

**4. Biosciences eastern and central Africa (BecA)**

| | |
|---|---|
| Status | NEPAD endorsed Initiative hosted and managed by the International Livestock Research Institute (ILRI) |
| Central management location | ILRI Campus, Kenya |
| Coverage | One central hub and 5 institutional nodes serving 17 African countries |
| Internet address | hub.africabiosciences.org |

**5. Partnership to Enhance Agriculture in Rwanda through Linkages (PEARL), 2000-2006/Sustaining Partnerships to Enhance Rural Enterprise and Agribusiness Development (SPREAD), 2006-2011**

| | |
|---|---|
| Status | Rwanda institutional partnership |
| Secretariat location | National University of Rwanda |
| Coverage | National University of Rwanda, Kigali Institute of Science and Technology, National Institute of Agriculture Research, NGOs that target agricultural cooperatives with over 15,000 member farmers in Rwanda |
| Internet address | www.spreadproject.org |

[10] Information on each network is derived from extensive documentation on their history, objectives, structure, and activities. Additional information came from exchanges with leadership and management staff, and with funding organizations and external advisers/evaluators.

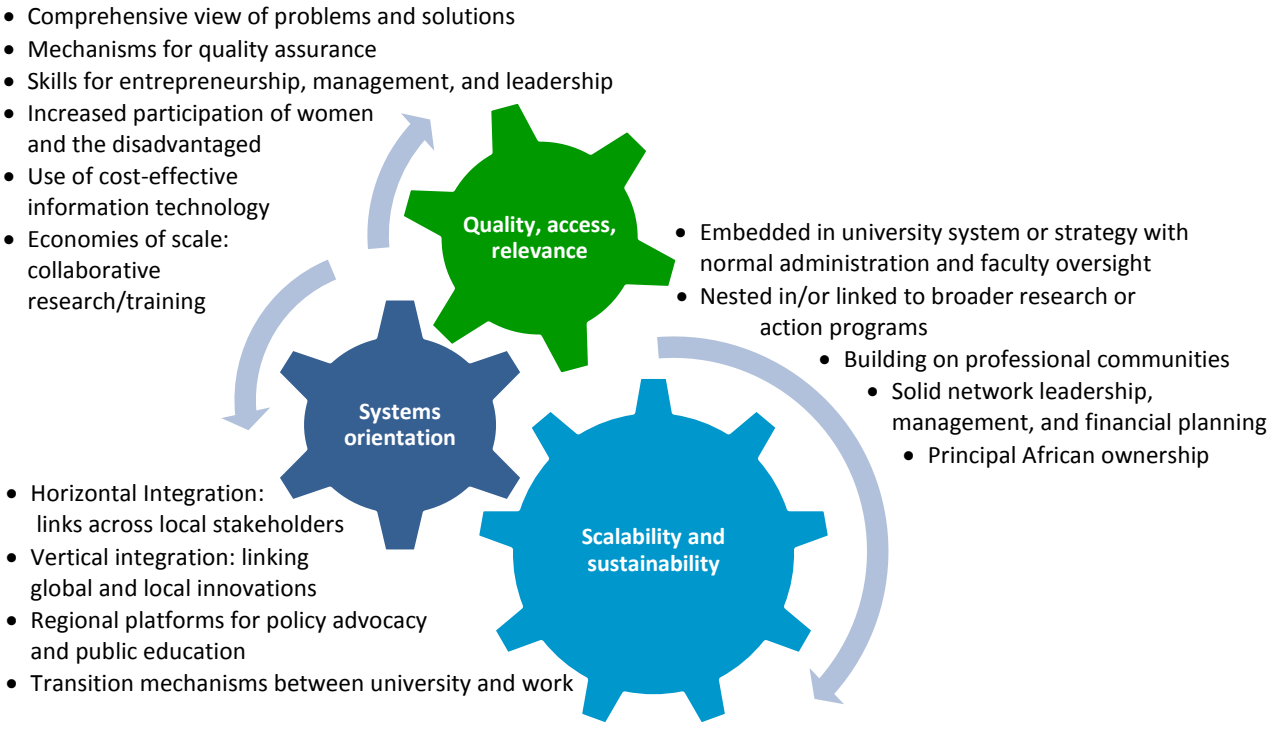
## NETWORK CHARACTERISTICS, PRINCIPLES AND CHALLENGES

Network formation in Africa has been a relatively autonomous process, often with considerable spontaneity and good fortune involved in their emergence. The result has been important differences in their format and use, both across and within sectors. Clearly, not every postgraduate training and research network in Africa requires a similar design. There are, however, a number of prerequisites for building capacity under fragile institutional circumstances that boost quality and relevance and lay the foundation for sustained expansion of the pool of qualified researchers. Such fundamentals generally fall into three categories: (1) quality, access, and relevance; (2) systems orientation; and (3) scalability and sustainability.

### Network Characteristics

Figure 3 illustrates these components as they relate to well-functioning networks engaged in postgraduate training; to research and institution strengthening in the agricultural sector; and, by extension, to cross-border networks in other fields.

**Figure 3. Components of viable network programs under tenuous institutional conditions**




Source: Devised by author.

The five agriculture training and research collaborations selected for closer examination offer the advantage of lifting *all* nodes in the network, significantly increasing the talent pool beyond the postgraduate fellowships provided and putting in place the conditions that lead to ongoing regeneration of human capital. Table 1 reviews the components listed above as they relate to each of the five networks.

**Table 1. Properties of promising agricultural research and development capacity building programs in Africa**

| | Program | | | | |
|---|---|---|---|---|---|
| **Design properties** | **Regional Universities Forum for Capacity Building in Agriculture (RUFORUM)** | **African Economic Research Consortium (AERC), Collaborative MSc in Agricultural and Applied Economics (CMAAE)** | **Alliance for a Green Revolution in Africa (AGRA), Education for African Crop Improvement** | **Biosciences eastern and central Africa (BecA)** | **Partnership to Enhance Agriculture in Rwanda through Linkages (PEARL)/ Sustaining Partnerships to Enhance Rural Enterprise and Agribusiness Development (SPREAD)** |
| **Description** | | | | | |
| | University network offering mentoring and research opportunities through competitive MSc (375) research grants, collaborative PhD training (85), a community-action research program, and institutional grants across 29 universities in 15 East, Central, and Southern African nations | Network of departments across 18 universities in 12 countries offering MSc (242), shared electives facility; recruited African and external subject specialists; PhD (11) support; department building grants; professional peer review | Network of 10 universities and 2 regional hubs feeding 13 countries; redeployment to national programs of PhD (80) and MSc (170) crop scientists and breeders; overseas university back-up | Hub and nodes model of top scientific expertise and facilities; access by visiting scientists (60) and MSc/PhD students (100) from African institutions; alumni lead research programs at home universities; return to BecA as visiting scientists supervising own grad students | Alliance of Rwandan universities, government, Rwanda/foreign industry, local NGOs targeting cooperatives in niche agriculture initiative; MSc training (19) at Texas A&M and Michigan State University; graduates train producers in new production techniques; based on U.S. land grant model |
| **Quality, access, relevance** | | | | | |
| Comprehensive view of problems and solutions | • Several multidisciplinary PhD and MSc programs<br>• Joint research methods courses | • Emerging topics of environment and natural resource management, and agribusiness | • Disciplinary concentration but value-chain orientation | • Wide variety of bioscience areas and related disciples | • Food sciences courses; new outreach center<br>• Value chain orientation |
| Mechanisms for quality assurance | • Competitive research award<br>• Peer review by a technical committee<br>• Aid to weaker universities | • Rigorous study/supervision<br>• Instructors' workshops<br>• External examiners, remedial courses | • Rigorous study/supervision<br>• External technical assistance (Cornell University, AGRA, and flagship hub staff ) | • Top-line labs<br>• "Hosted programs" by senior African or international scientists with own postdoctotal and graduate students | • Initial MSc courses in the United States for local staff development |
| Skills for entrepreneurship, management, leadership | • "Soft skills" relevant to the needs of farmers and business<br>• Hands-on problem solving<br>• Participatory research | • Attachments to organizations that provide management and leadership proficiency | • 1 to 4 month, hands-on training and attachments to private sector or international organizations with management expertise | • Emerging science leaders as BecA affiliates who then lead/manage own research teams | • Work with Rwanda Coffee Board adds management skill to help grower co-operatives to build export businesses |
| Initiatives to increase female participation | • 28 percent female participation; aiming for 40 percent<br>• Multiple mechanisms for recruitment, career launch and skill utilization/retention | • 35 percent female participation; aiming for 40 percent<br>• Multiple mechanism for recruitment, career launch, and skill utilization/retention | • 40 percent goal with recruitment assisted by the ICRAF AWARD program | • Currently 41 percent of 88 graduate students are female | • 31 percent of graduate students are female |
| Use of cost-effective information technologies | • Improved information technologies applications and knowledge access systems | • Improved information technologies applications and knowledge access systems<br>• Work with Open Educational Resources Africa | • Digital networking<br>• Electronic libraries<br>• Video-recorded lecture series | • Latest bioinformatics tools and services<br>• BecANet on-line resources | • Internet café<br>• Connectivity via fiber optic cable<br>• Geographic information systems and remote sensing |
| Economies of scale: joint research and training facilities | • Competitive MSc research schema<br>• Eight joint PhD and MSc programs each at lead university | • Standardized curriculum<br>• Joint electives facility<br>• Joint faculty grants | • Standardized curriculum<br>• 2 "flagships" of excellence for PhD training | • Linked with five institutions<br>• Co-supervision of theses<br>• Traveling seminars | • Collaboration across universities, Agricultural Research institute of Rwanda, and farmer cooperatives |

**Table 1. Continued**

| Design properties | Program | | | | |
|---|---|---|---|---|---|
| | Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) | African Economic Research Consortium (AERC), Collaborative MSc in Agricultural and Applied Economics (CMAAE) | Alliance for a Green Revolution in Africa (AGRA), Education for African Crop Improvement | Biosciences eastern and central Africa (BecA) | Partnership to Enhance Agriculture in Rwanda through Linkages (PEARL)/ Sustaining Partnerships to Enhance Rural Enterprise and Agribusiness Development (SPREAD) |
| **Systems orientation** | | | | | |
| Horizontal integration (across local stakeholders) | • National Forums engage farmer organizations to keep university research on track | • Links with national governments, national agricultural research systems, the local private sector, CGIAR centers, and non-governmental organizations | • Training with CGIAR centers<br>• Investments in national agricultural research systems and seed business services | • Collaboration with the New Partnership for Africa's Development, biosciences networks, local universities in national agricultural research systems, industry | • In-country partner institutions<br>• Demonstration sites and market outlets for agricultural products |
| Vertical integration (across global and local innovation) | • Potential World Bank backed facility in planning stage<br>• Back-up by Costa Rica's Earth University and others for field work innovations | • World-class universities, World Bank Institute, United Nations bodies and industry ensure international standards | • Global agricultural initiatives and funding streams<br>• Back-up by world-class research institutes | • Industry partnerships, African Diaspora, and global science communities for product incubation/innovation | • Global coffee and other crop markets<br>• Back-up by world-class universities |
| Regional platform for policy advocacy, public education | • Links with CAADP process, the AU, FARA, and many others | • High-level public policy analysis seminars<br>• Faculty research and thesis local dissemination | • Use of AGRA strong communications channels<br>• Links with all major regional policy bodies | • Publications with wide dissemination in Africa and overseas<br>• Broad policy links | • Demonstrations, outreach center, radio and extension<br>• Internet access to agribusiness community |
| Transition mechanisms between university and work | • Three-month field attachments to CGIAR centers, in national agricultural research systems, or firms<br>• Earth University to help prepare graduates for research or start- up enterprises | • Consultation with public–private sector employers<br>• Provision for internships and job placement | • CGIAR and in national agricultural research systems programs mentor graduate students<br>• Absorption of grads in AGRA supported programs | • Exposure to international expertise offers career development opportunities | • Graduates placed in universities and outreach positions providing technical assistance to growers |
| **Scalability and sustainability** | | | | | |
| Nested in university system/ strategy; normal administration and faculty oversight | • Deliberate mechanisms to diffuse new ideas and practices across the university system<br>• Content organically grown to fit faculty strategic plans | • Offers spillovers from focal centers to similar disciplinary departments in other universities<br>• Content organically grown to fit faculty strategic plans | • Focal centers stand out from others<br>• No obvious mechanisms for influencing broader training standards at host universities | • Decentralized capacity in individual BecA nodes in specified fields | • Engaging students in community work influences broader teaching styles at universities<br>• No obvious mechanism for systematic spillovers |
| Building professional communities | • Alumni involved in groups attached to each research theme, electronic networks, biennial meetings, annual network workshops, and so on | • Created African Association of Agricultural Economists that sponsors global conferences for young and senior scientists to share knowledge | • Graduates generally become part of the AGRA family | • Synergies with university nodes extend to other biosciences networks<br>• Predicted 15 percent student growth per year over next five years | • Professional links across academia, government, and industry<br>• Through outreach center, graduates may eventually handle all marketing and exporting of crops |
| Solid network leadership, management, and financial planning | • Strong director<br>• Streamlined secretariat<br>• Knowledge/evaluation management<br>• Careful finance/auditing<br>• New business plan | • Strong leadership<br>• Streamlined Secretariat under AERC<br>• Knowledge/evaluation management<br>• Careful finance/auditing | • Strong AGRA staff provide overall leadership<br>• Strong program operations management at participating universities | • Strong director<br>• Leadership unit manages institutional arrangements under ILRI<br>• New business plan | • Recent change in leadership<br>• Secretariat at NUR linked with Texas A&M University<br>• Continued growth needed before the coffee value chain becomes self-sustaining |

**Table 1. Continued**

| Design properties | Program | | | | |
|---|---|---|---|---|---|
| | **Regional Universities Forum for Capacity Building in Agriculture (RUFORUM)** | **African Economic Research Consortium (AERC), Collaborative MSc in Agricultural and Applied Economics (CMAAE)** | **Alliance for a Green Revolution in Africa (AGRA), Education for African Crop Improvement** | **Biosciences eastern and central Africa (BecA)** | **Partnership to Enhance Agriculture in Rwanda through Linkages (PEARL)/ Sustaining Partnerships to Enhance Rural Enterprise and Agribusiness Development (SPREAD)** |
| Principal African ownership | • African Secretariat<br>• Vice Chancellor Board<br>• Technical and deans committees<br>• Thematic working groups | • African Secretariat<br>• Board composed of funders and independent directors<br>• Content oversight by African program committee | • Sponsored by AGRA<br>• Absence of a local participatory academic board | • African leadership<br>• ILRI Board provides fiscal over-sight, policy and strategic guidance<br>• intent to build interactions between ILRI and AU/NEPAD | • Sponsored by USAID with external university technical assistance<br>• Program is Rwanda led |
| Principal funding source | • Rockefeller Foundation initially<br>• Currently the Bill and Melinda Gates Foundation with others<br>• University members contribute $5,000 in annual fees | • 13 donor agencies and 3 African governments support AERC<br>• Earmarks for CMAAE mainly from the Bill and Melinda Gates Foundation, AGRA, ACBF | • The Bill and Melinda Gates and Rockefeller foundations | • CIDA, AusAID, Syngenta Foundation for Sustainable Agriculture<br>• Aim to generate 50 percent of future support from research projects | • USAID |
| Major agricultural sector results | • Multiple initiatives have put in place new crop varieties in cooperation with NARS, farmer associations and private sector<br>• Examples: Cowpea project in Uganda, Soyabean project in Zimbabwe; Cereal Banking, Kenya | • Executive policymaker guidance<br>• Policymaker career pipeline<br>• Management hub of World Food Program's Purchase for Progress project to address small-scale farmers' market access | • Released 125 new crop varieties with national/international research institutes for farmer cultivation<br>• Related projects include start-up capital for 35 seed enterprises and training 9,200 agro-dealers for input provision | • Over 29 bioscience projects on crops and livestock<br>• Patented discoveries and over 40 cutting-edge publications that feed the work of CGIAR, NARS, other research institutes in Africa | • Around 400,000 coffee farm families making over six times what they earned prior to these projects<br>• Over 160 U.S. European, Asian and Australia companies like Starbucks, Costco buying almost 5,000 tons annually, directly from the growers |

Source: Compiled by author.

Notes: ACBF is the African Capacity Building Foundation; AU is the African Union; CAADP is the Comprehensive Africa Agriculture Development Program; CIDA is the Canadian International Development Agency; CGIAR is the Consultative Group on International Agricultural Research; FARA is the Forum for Agricultural Research in Africa; ILRI indicates the International Livestock Research Institute; NARS indicates national agricultural research system; NEPAD is the New Partnership for Africa's Development; USAID is the United States Agency for International Development.

These networks are demonstrations of key mechanisms for fast-tracking training and for building research capacity through collaborative arrangements among better endowed institutions and those less well-off on the continent. As noted by Juma (2011: 63), the flow of knowledge among institutions of advanced learning and between them and enterprises through networking facilitates the formation of "dynamic self-teaching systems" that speed up innovation.

Together these collaborations reflect a remarkable change in learning strategies by cash-strapped African universities. The sample networks are not alone. Other *current* capacity building networks of note within agriculture include (1) The African Network for Agriculture, Agroforestry and Natural Resources (ANAFE), which assists university faculties, particularly in West Africa, to undertake curriculum reviews, facilitate staff exchanges, and develop teaching materials; (2) the Building African Scientific and Institutional Capacity (BASIC) network, initiated by FARA to improve teaching methods and course content; (3) AGRA soils network, offering PhD courses at two training hubs, as well as MSc studies at individual universities; (4) AWARD, a two-year fellowship for fast-tracking the careers of female agricultural scientists hosted by on the World Agroforestry Centre (ICRAF); and (5) the Association of African Business Schools, which offers quality control and an added focus on the smaller scale and informal private sector in delivering essential public goods, and on the not-for-profit sector providing public health and agricultural business services.

There are also models of network approaches in other sectors that offer the potential for adaptation in agriculture. These provide direct links from the individual through the institution to the larger sectorial space (as in Figure 1). Three seem particularly germane for this discussion:

- The AERC PhD economics program offers subregional catchment zones involving host and associated universities from which students and the bulk of teaching faculty are drawn. The design, involving professional peer review, enables capacity building spillover to a large number of universities. Program oversight comes from a PhD Academic Board comprising the heads of member departments and senior African scholars who contribute to the maintenance of international standards (www.aerc.org).
- The INDEPTH network is a learning platform of multi-site demographic surveillance collaborations offering on-site training and internships, standardized research methods, and mechanisms for translating research on public health priorities into policy outcomes. By sharing data and results they allow researchers to form the "big picture" from multiple experiments and venues. An associated MSc degree is accredited by the University of Witwatersrand in South Africa. INDEPTH has scaled-up as many as 34 sites in 19 countries, with 23 sites in Africa (www.indepth-network.org).
- The Consortium for Advanced Research Training in Africa (CARTA), a program of the African Population and Health Research Center (APHRC) and the University of the Witwatersrand in South Africa, fosters the development of viable training and training hubs at nine universities across Africa. Its major features are a first-rate, joint advanced seminar package, opportunities for mentored research at any one of the network universities, and program back-up through expertise from four leading African research institutes and seven Northern institutions (www.aphrc.org).

It should be noted that a major impetus for strengthening agricultural training and research networks comes from improvements in national higher education policy and from individual universities

that attempt to align university studies with national development priorities, especially with regard to agribusiness.[11]

**Underlying Principles and Challenges**

Despite an array of strong agriculture postgraduate and research networks, the networking concept is still evolving. All too often, for a variety of reasons, emerging networks fall short of meeting their promise to advance higher learning and ultimately agricultural performance. First, the number of qualified universities for advanced training and participation in research networks is still small, with many aspirants unable to meet fundamental standards for teaching and research and, hence, for accreditation or world recognition of degrees.[12] Second, rushed planning under heavy pressure from potential funders can result in poor design and impeded implementation. Third, attempts to build alliances among universities and between them and the larger agricultural innovation system can lead to frustration if they fail to create added value for all members. Fourth, many networks never reach the take-off point because they do not use their assets strategically to produce significant public goods. Fifth, collaborative arrangements may easily breakdown if partners do not reach early agreement on common interests, expectations, and contributions. Such prior negotiations offer high organizational payoff especially in the event of tight fiscal conditions.

The shortcomings of many networks provide the backdrop for a set of general principles underlying the construction and improvement of postgraduate training and research collaborations in agriculture. In general, these networks need to concentrate on problems requiring collective action, and need to pool their talents to reach critical mass and synergy and realize creative solutions. Specific actions include the following.

**Aligning vision and mandate with national aspirations.** A network is defined by its interaction with the professional field in which it operates and by the benefits that it affords its members. For agricultural networks, a key goal is to establish productive relationships with other actors in a country's innovation system through an ongoing consultative process (Spielman et al. 2008). Of the sample networks, one is designed specifically to build an export business in several crops to revitalize the agricultural sector. Thus, for PEARL/SPREAD, turning higher education toward understanding the dynamics of Rwanda's government and commercial sector has been paramount. BecA and EACI are seeking capacity strengthening through research and product incubation or varietal releases. Both are gearing themselves to complement parallel reforms occurring in CGIAR and national research systems in support of smallholder commercialization and public/private sector investments. RUFORUM holds the conviction that the research results of well-trained scientists are more likely to be applied when based on a demand-driven research agenda. Thus, it has created national forums now operational in seven countries that serve as stakeholder discussion platforms and policy advocacy units. For CMAAE, the task is to remedy mixed quality standards in a well-established field and ensure that sound research draws the attention of policymakers and helps to structure the policy debate. In each of these cases, the success of the network is a function of how closely its vision fits with the political and organizational

[11] University innovations aimed at better links with agribusiness and markets include (1) agribusiness incubators (for example, Jomo Kenyatta University of Agriculture and Technology, Kenya; Makerere University, Uganda; Institut Polytechnique Rurale, Mali, University of Zimbabwe); (2) development of student agribusiness plans (for example, United States International University, Kenya; University of Swaziland, University of Malawi, University of Ghana); (3) science parks (for example, Egerton University, Kenya; Institute of Food Technology, University of Pretoria); (4) Memoranda of Understanding with district agricultural offices (for example, Makerere University, Uganda); and (5) agriculture partnerships with cooperatives (for example, National University of Rwanda) and with companies (for example, University of Agriculture Abeokuta, Nigeria).

[12] Professional networking and institutional linkages appear to be better among Anglophone countries, given that they possess nearly four times as many agricultural researchers as do Francophone countries (World Bank 2007b).

context. Of the five networks, one was conceptually pre-tested in a pilot effort; each of the others emerged following a serious reconnaissance of the landscape in which it would function.

**Determining core competencies and comparative advantage.** While fitting into the national agricultural system landscape is critical, a network also needs to establish a clear strategy for staff and stakeholders to follow to avoid inefficient opportunism and missed opportunities for impact. Building on core competencies might involve growth by adding new services to current members or by balanced or sequenced growth strategy adding new activities or regions while making careful tradeoffs among activities to avoid dilution of effort, strain on management, and loss of brand value.[13]

**Ensuring that new approaches in academia can be mainstreamed within the university system.** Networks featuring highly innovative characteristics that attract members and keep them intellectually stimulated may find that they are not well-aligned with member university processes and normal faculty strategic planning. Without the engagement of a local academic board or similar body, network-induced reforms can provoke resistance from administrators and hinder spillover effects to other departments and universities.[14] There are deeper structural challenges to spillover from networks into institutional strengthening of the *larger* university system. In particular, four of the networks, with the exception of RUFORUM, are grounded in disciplinary professions with principal links outside universities to clientele using those disciplines that have an interest in the quality of the graduate and the research on which much of the value and relevance is based. Capacity to produce spillovers into the wider university space runs along a continuum with the highly disciplinary-focused EACI on one end, and RUFORUM with its multiple disciplines and cross-disciplines on the other.[15] RUFORUM is the only network of the five deliberately designed to connect investments in individuals and faculties to improvements in the wider university body. It does so mainly in three ways: (1) focusing on commonalities at the margins of agricultural disciplines and overlapping methodologies (for example, its highly popular network wide research methods courses); (2) working with a wide-ranging committee of university deans; and (3) instituting a board composed of vice-chancellors of member universities who pay annual membership fees and cover their own travel expenses to meetings. It might be argued that with such layering, RUFORUM operates at too broad a level and that viable networks are best grounded in single professional disciplines with reach to external constituencies that provide essential feedback loops. In the end, however, lasting gains in strengthening institutions and raising professional standards may best be realized if networks put a premium on diffusing new ideas and practices throughout individual universities and across them to a variety of agricultural system stakeholders.

**Increasing the participation and voice of women**. There are multiple mechanisms for drawing women into postgraduate programs, helping them with career development and ensuring utilization and

[13] Both BecA and RUFORUM have carefully laid out various pathways for growth in their new business plans; CMAAE/AERC has commissioned a study on ways to reformat its collaborative research activities; and EACI and SPREAD are proposing new lines of work in their next phase.

[14] CMAAE, for example, receives oversight from an Academic Board, a body consisting of the heads of departments participating in the program and other senior African scholars actively involved in graduate teaching and research. This body (1) contributes to the establishment and maintenance of international standards by making recommendations on operating policy (such as the criteria and procedures for accrediting collaborating departments to offer the program) and (2) conducts various evaluations to ensure continued quality and relevance.

[15] Under the PEARL/SPREAD programs, changing the curriculum of the agricultural faculty under a participatory, step-by-step approach to link with local enterprises has, according to SPREAD's director, more broadly affected the way teaching takes place at the National University of Rwanda. One example is the recent launch of an integrated health component within the agribusiness program (Kayisinga, personal correspondence 2011). The programs, however, have no explicit mechanisms for generating these effects.

retention of skills. These include creating a database of active female researchers, inviting women to participate in various network committees and activities, providing faculty deans with incentives for recruitment, using role models and mentoring, bolstering women in entrepreneurial initiatives, and creating back-up supports for female scientists who work with female farmers. There is no doubt about the desire of women to enter a professional career track in agricultural science. The AWARD program reports that this year there were 785 applicants from 11 African countries—more than 10 times the number of available fellowships. In the future, AWARD aims to place more emphasis on working with research and academic institutions to help fellows build their capacity for gender-responsive research (Waruru 2011).

**Investing in appropriate information technologies.** Wise investment in low-cost technologies provides unprecedented opportunities for building network capacity to support effective, decentralized learning and knowledge sharing. All of the networks featured here are harnessing powerful new information and communications technologies to improve the performance of management and of the universities and other entities they serve. The uses include technology-mediated learning, teaching, and research; employment of open educational resources; dissemination of agricultural research information;[16] and network information management systems. In addition, cell phones, hand-held computer devises, video, and radio provide relatively cost-effective distribution of scarce specialist teaching resources to reach many students conducting field research, community organizations, and other network stakeholders.

**Identifying the full range of clientele**. In its new business plan, RUFORUM recognizes the different demands of three types of clients: (1) member universities; (2) users of the outputs of RUFORUM programs, such as new graduates; and (3) global and regional partners and funding agencies. The distinction is important as it differentiates among (1) RUFORUM members who derive special benefits from membership and may be willing to pay higher membership fees for "club goods"; (2) employers of graduates who pay market rates to the individual graduate that may include a quality premium; and (3) demand for public-good knowledge about universities and networks as bridging organizations among academia, NARS, policymakers, and the private sector. The finance dilemma is getting the customers to cover the full cost of having and maintaining RUFORUM (RUFORUM 2011b). The network now meets the demand for products and services by adding value to the contribution of each of its customers in different ways. A decision to change the balance of its services in favour of new customers will have important implications for funding as well as for the nature of its core functions.

**Designing strategies for cost-recovery and growth at a manageable scale.** Without core funding, networks cannot function on sufficiently strong a footing to negotiate agreements among partners, establish priorities, invest in serious planning, and build organizational integrity to stay on course. However, many donors tend to prefer short-term project support, which can redirect priorities, overextend management, and leave the organization without the necessary funds to cover direct and indirect costs.[17] While changing local and global contexts drives the need for networks to evolve, growth will require full-cost recovery for staff and operations so that the core is progressively strengthened.

[16] Lower cost online and offline journals, such as AGORA and TEEAL, wiki-type platforms, blogs, and other knowledge-sharing technologies offer potential for an enormous increases in collaborative learning. Recently, the Google Foundation has undertaken to use its technical expertise free of charge to help African networks set up information technology platforms for digital libraries and on-line forums.

[17] For example, RUFORUM has found itself pulled in many directions by its supporters and, in some cases, without the necessary project funding to cover full costs of operations. Its attractive concept has also resulted in rapid scaling (10 members in 2004, to 25 in 2009, to 29 in 2011) by universities, several quite weak, wishing to benefit from spillover knowledge from stronger institutions.

Networks face three classical problems: (1) public goods are always underfunded because everyone can have access to them without paying ("free-riding"), (2) the users of graduates from network programs do not have to finance the fellowships of students because they can hire the products on the market, and (3) member insitutions seldom have independent resources to fund a network (RUFORUM 2011b).[18] These organizations, then, must design a differentiated resource mobilization strategy for each market segment, while recognizing that a majority share of support will need to come from donors or through governments by way of multilateral organization loans for sometime to come.[19]

**Contributing to enhancement of the policy environment.** Networks can play a leading role in building knowledge and skills for improving policymaking in a shifting policy and institutional environment. They can serve as a convening force, bringing researchers and other agricultural stakeholders in closer contact with policymakers, channeling cross-country experience into national policy debates and making those debates more evidence-based. Still, there is always the danger of naïve assumptions on the part of researchers that strong scientific findings are by virtue of their "dispassionate" observations and analyses routinely used in the policy formulation. The process of utilization in policymaking is far more complex, especially the impact of broader contextual factors, such as the political and institutional environment. Understanding of realistic policy options is facilitated by interaction with those charged with making policy decisions. Grasp of the nuances within which policymaking takes place can assist networks in having much greater impact on policy formulation and implementation (Bailey 2010).

**Building strong management and governance.** Responding to the divergent demands and capacities of the various stakeholders and raising funds are only two of the major pressures on those who manage networks. These alliances require efficient and transparent governance and advisory structures, often involving representatives from membership countries and institutions. Management has responsibility for priority setting, investment in financial and reporting systems, convening, communicating with members and funders, and development of multi-year business plans that sustain the organization. Day-to-day administration of the network's activities is performed as required. Clearly, networks have high transaction costs associated with assembling people from multiple institutions and geographies. These intricate organizations require a secretariat or host institution steeped in talent, especially at the leadership level, and with appropriate facilities. Yet quality management, which funders demand, entails administrative overheads, which they find objectionable. While there is no simple solution to this problem, overheads should be treated as a legitimate cost reflected within an approved business plan and budget.

**Fostering sustainability through better evaluation and risk management.** As most networks are donor dependent, their longevity and potential scaling are linked with changing funder preferences. While this

[18] Private-sector funding of research in African universities is very small. Expansion would require a strategic framework in universities to encourage university–industry linkages, and government policy support. To explore this potential, the Association of African Universities has formed a partnership with the Association of Universities and Colleges of Canada (Mohamedbhai 2011).

[19] BecA's business plan aims to reach a breakeven point and ensure its financial sustainability based on three core business areas: (1) capacity strengthening predominantly funded by donors, (2) research and research services through Hosted Programs funded by various clients' research grants or hosted institutions, and (3) product incubation and innovation funded by clients with product development programs. Fundraising plans by other networks include developing university cluster proposals using the network platform; bringing research proposals in line with large-scale, country-level agricultural initiatives; assisting member universities to establish memoranda of understanding with district agricultural offices to upgrade staff under a fee-based service arrangement; indirect grants via partner networks (possibly as subcontractors); creating an innovation fund; establishing an endowment from member and alumni contributions; and placing head of ministries, directors of central banks, or private sector chief executive officers on boards.

is difficult to alter under current African circumstances and probably into the foreseeable future, there are at least four constructive steps that can be taken to lessen funding shocks. First is gathering momentum and attracting funding by building a common "brand" of excellence and reliability that gains legitimacy and financial support. Second is an evaluation strategy co-designed by management and funders that, while not necessarily settling the sustainability issue, can reduce what might appear as random decisions by funders based on inadequate information (Prewitt 1997).Third is to have in place a practical business plan to identify customer segments, a viable growth model, legitimate costs, potential funding streams, and risk mitigation strategies. Fourth is to recognize that scaling up, with reference to breadth of operations and financing, may present risks for individual funders, especially in the context of long-term commitment. Spreading the burden among a broad group of supporters can provide a solution (Fine 2007b), as well as hold the line on core funding. Diversifying the funding base, however, should be done as early possible to avoid the impression of network "ownership" by a single donor agency.

## 3. FUTURE CONSIDERATIONS

The purpose of this discussion is to highlight some key features and guiding principles of assistance to those engaged in forming, fortifying, and supporting professional capacity building networks in the agricultural sector. The type of networks featured here are critical mechanisms for building the next generation of innovation-minded agricultural scientists in Africa. They are major vehicles for launching and maintaining scientific careers. Their uniqueness as organizational forms comes from features embedded within profession-enhancing strategies.

In future, such strategies will need to accommodate global market forces given that scientists are more likely in their professional lifetimes to move from place to place, or work for multiple employers simultaneously. Many networks are already helping their members to initiate reforms, especially in terms of institutional flexibility and innovation that will position them to face new competitive challenges. This may include transferability of qualifications and course harmonization across universities, organizing research universities within ever more differentiated systems, joint faculty appointments, "split-site" doctoral training within and outside Africa, shared facilities under a common research and training platform, and simplified administrative mechanisms.[20]

In the future, evolving information and communications technologies may enable faculty to be somewhat independent of their universities. The best faculty with multiple chairs in Africa and overseas may be able to video-in their lectures while sitting at a different base than their home university. In addition, future faculty—unfettered by traditional university procedures—may be primarily based in non-university settings, such as government ministries, NGOs, NARS, private businesses, think tanks, and so on, and work on contract for universities for a portion of their time. Alternatively, universities with advanced technologies and equipment could outsource services to commercial providers or public-sector facilities, both as a means of raising cash and exposing students and staff to new learning environments.

The future restructuring of agricultural higher education in Africa may rest on new levers for transformation, including (1) populist movements toward tackling long-standing problems of inequities and exclusion; (2) the reorganization of knowledge systems to accommodate emerging complex fields, such as climate change, that demand overcoming disciplinary barriers to problem formulation and problem-solving, and require renewed appreciation of indigenous bodies of knowledge; (3) the growing importance of the private sector and value chains compelling the incorporation of a business school *optique* into research and training; and (4) the effects of globalization as the reduction of time and space

[20] See Aina (2010) for a general discussion of the politics of higher education transformation in Africa.

influences relationships among institutions, knowledge production, and other agents of the agricultural innovation system.[21]

A successful professional network will, in the long-term, be characterized by its ability to keep researchers in Africa, keep them scientifically active, and focus them on making measurable contributions to the broader system of innovation in the agricultural sector. Yet, even with evidence that networks are critical elements of the institutional landscape of professional capacity-building in Africa; the role is a reinforcing one. They cannot take full responsibility for the rejuvenation of universities and research institutes. Networks support and complement but do not replace these essential institutions. The crucial role of networks over the next decade is to ensure that the bond between higher education and practical, problem-solving science and technology capacity in Africa is a sturdy one backed by expanded access to technical resources, peers, reliable finances, and genuine local buy-in for sustained political support.

Funding agencies and others have an opportunity to play a more active role in strengthening the ways in which education and research contribute to enhancing innovative capacity in the agricultural sector. Over the past two to three decades, international development agencies have tended to focus more on professional skills than on building institutional capability. They have stressed technical and analytical tools over problem solving and policy relevance. They have placed greater emphasis on pipeline production of professionals rather than on their career tracks and skill utilization. And they have promoted the strengthening of individual institutions over the coordination among multiple, differentiated institutions that can advance and sustain entire professional fields (Moock 2005).

The examples offered here of current collaborative initiatives in agricultural research and development capacity building testify to creative thinking about the serious challenges at hand. These networks have in their DNA the recognition that success depends on translating knowledge into innovation and application. They are responding to a new realism voiced by Africa's political, business, and science leaders who recognize the need to devise fresh, bold, even radical approaches to fields of learning and research appropriate to the times, and invest in credible yardsticks for appraising these investments. It is a safe bet that the number of such networks will continue to grow.

[21] The dynamics of globalization inherently compel durable, mutually supporting partnerships with advanced learning institutions outside Africa. These might include staff and student attachments in both directions and shared research. A major advantage of strong cross-institution, Africa-based networks is the portal they offer world class external institutions for joint learning and intellectual exchange. The problem is how to seize this benefit without allowing powerful external bodies to have undue impact on the network's core agenda and comparative advantages.

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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.

The conference was funded by the Bill and Melinda Gates Foundation and FARA.