

## THE AGRICULTURAL R&D CHALLENGES OF SMALL COUNTRIES IN SUB-SAHARAN AFRICA

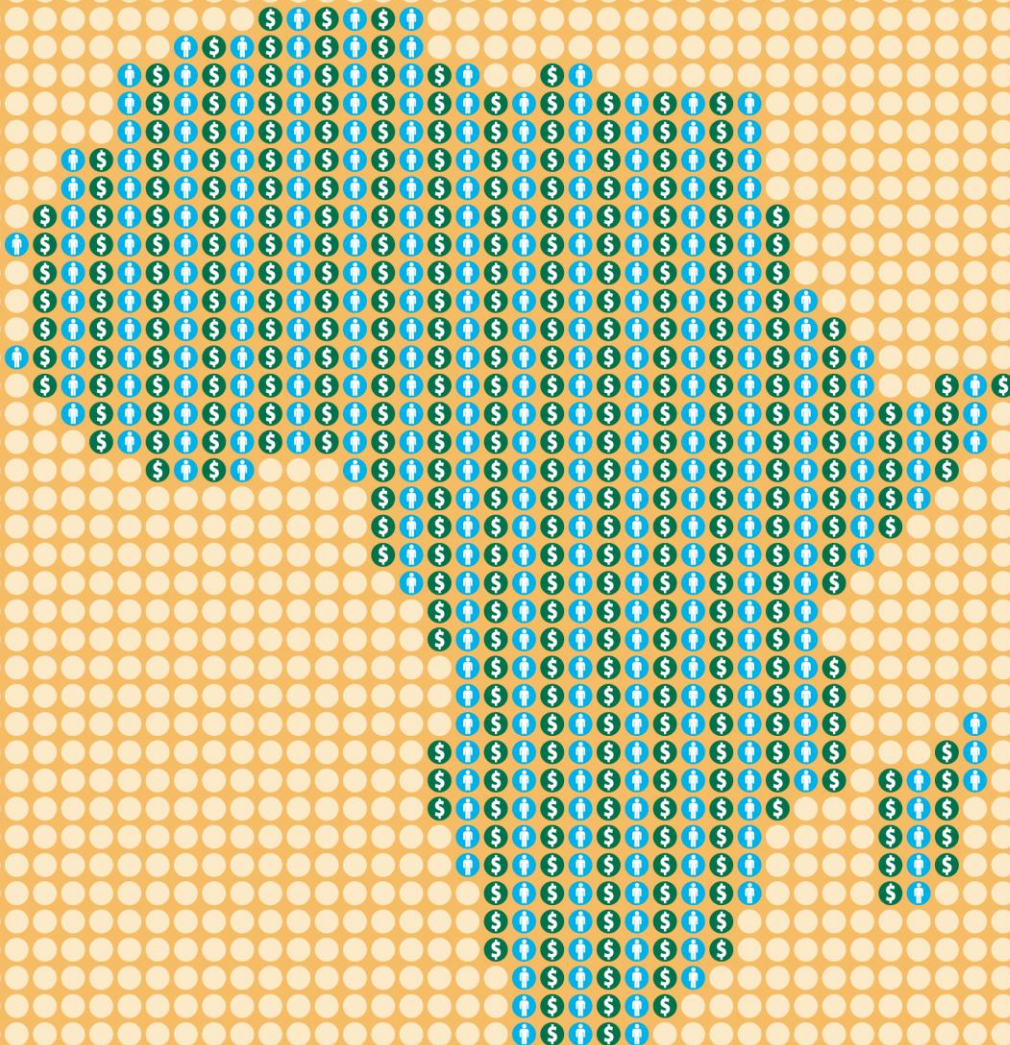
Kathleen Flaherty

Conference Working Paper 3

Prepared for the ASTI/IFPRI–FARA Conference | Accra, Ghana | December 5–7, 2011

### AGRICULTURAL R&D: INVESTING IN AFRICA'S FUTURE

Analyzing Trends, Challenges, and Opportunities





## Table of Contents

1. Introduction.....	1
2. The Challenges Small Countries Face in Conducting Agricultural Research .....	2
3. Agricultural Research in the “Smallest of the Small” .....	6
Institutional Structures.....	7
Human Resources.....	10
Financial Resources .....	12
4. Conclusion .....	14
References .....	15

## List of Tables

1. Comparison of research systems, various years .....	1
2. Lessons from a small-country study.....	5
3. Overview of the smallest countries, 2008.....	6
4. Number of agencies and FTE researchers involved in agricultural research, 2008 .....	7

## List of Figures

1. Size distribution of research agencies, 2008.....	8
2. Agricultural researchers by major sector, 2008 .....	8
3. Agricultural researchers by institutional category, 1991 and 2008 .....	9
4. Agricultural researchers by degree qualification, 2001 and 2008 .....	11
5. Funding sources of main government agencies, average 2001–08 .....	12

## **About the Author**

**Kathleen Flaherty** (k.flaherty@cgiar.org) is a data analysis specialist with the Agricultural Science and Technology Indicators (ASTI) initiative of the International Food Policy Research Institute.

## **Acknowledgments**

The author thanks Mary Jane Banks for editing the paper and Nienke Beintema, Gert-Jan Stads, John Lynam, and an anonymous reviewer for comments provided on a draft of this paper.

## Acronyms and Abbreviations

AgGDP	agricultural gross domestic product
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
CAADP	Comprehensive Africa Agriculture Development Program
CENAREST	National Scientific and Technological Research Center (Gabon)
CORAF/WECARD	West and Central African Council for Agricultural Research and Development
DGRST	General Delegation of Scientific and Technical Research (Republic of Congo)
EAAPP	Eastern Africa Agricultural Productivity Program
FAAP	Framework for African Agricultural Productivity
FANR	Food, Agriculture, and Natural Resources
FARA	Forum for Agricultural Research in Africa
FTE(s)	full-time equivalent(s)
IFAD	International Fund for Agricultural Development
IMROP	Mauritanian Institute of Oceanographic Research and Fisheries
IRAF	Agricultural and Forestry Research Institute (Gabon)
ISABU	Burundi Institute of Agronomic Sciences
ISNAR	International Service for National Agricultural Research
ITRA	Togolese Agricultural Research Institute
NARI	National Agricultural Research Institute (The Gambia)
NEPAD	New Partnership for Africa's Development
NERICA	New Rice for Africa (African Development Bank–financed project)
PPP	purchasing power parity
R&D	research and development
RPSDP	Rural and Private Sector Development (World Bank–financed Project)
S&T	science and technology
SADC	Southern Africa Development Community
SLARI	Sierra Leone Agricultural Research Institute
SRO(s)	subregional organization(s)
SSA	Sub-Saharan Africa
WAAPP	West Africa Agricultural Productivity Program

## **Abstract**

Sub-Saharan Africa (SSA) has a number of small countries, almost all of which also qualify as having small agricultural research systems. Small countries face particular challenges when undertaking agricultural research and development (R&D). They are characterized by low capacity and vulnerability to funding volatility and are limited in their ability to take advantage of economies of scale and scope. The complexity of agroecosystems, crop preferences, and farming systems in these countries places considerable demands on small research systems and requires that researchers have an advanced level of technical expertise, yet with a multidisciplinary background. However, small countries are less likely to have graduate programs in agricultural sciences. Although they have many challenges in common, the diversity of small country agricultural research systems—in terms of capacity, investments, funding sources, research priorities, institutional arrangements, and policy environment—generally gives rise to numerous unique challenges as well.

This paper provides a review of some of the challenges small countries face in conducting agricultural research, particularly in terms of investment levels, institutional arrangements, capacity, and sources of funding. Some policy developments that may have implications for small countries, including greater support for subregional approaches, are also discussed. The paper also assesses recent developments in some of the smallest countries in the region to illustrate the diversity of agricultural research systems.

## 1. INTRODUCTION

Sub-Saharan Africa (SSA) has a number of small countries, almost all of which also qualify as having small agricultural research systems. Small countries face particular challenges when undertaking agricultural research and development (R&D), including limited human resource capacity, the inability to benefit from economies of scale, and sustainability problems. And although they have many challenges in common, the diversity of their agricultural research systems—in terms of capacity, investments, funding sources, research priorities, institutional arrangements, and policy environment—generally gives rise to numerous unique challenges as well.

Regional agricultural research capacity and investment levels in SSA can be more applicably compared with countries like India and the United States (Table 1). Despite employing similar numbers of researchers, public agricultural research in SSA is conducted at 353 different agencies, compared with 131 in India, and 51 in the United States.<sup>1</sup> Economies of scale are often lost when research is so fragmented. Moreover, Africa’s agroecosystems and farming systems are quite complex, whereas institutional environments are less conducive in these small countries, limiting straightforward technological spillovers. In addition, many of the diverse crops Africans depend on for food security are considered “orphans,” meaning that they are noncash crops of little commercial interest, and hence are neglected by the private sector and commodity-based research centers.

**Table 1. Comparison of research systems, various years**

Indicators	Sub-Saharan				United States
	Africa	Brazil	China	India	2008
	2008	2006	2007	2003	2008
Arable and permanent crop area (million hectares)	205	69	122	170	166
Population (million)	821	188	1,317	1,064	304
Agricultural labor force (million)	186	12	505	249	3
Agricultural GDP (million 2005 PPP dollars)	284,567	72,735	743,538	396,585	151,928
Number of public agricultural research agencies <sup>a</sup>	353	130	1,105	131	51
Number of public agricultural researchers (FTEs)	12,120	5,376	70,000	13,089	9,965
Share of researchers with a PhD degree (percent) <sup>b</sup>	30	75	<30	55	100
Annual public spending on agricultural R&D (million 2005 PPP dollars)	1,741	1,307	3,626	1,426	4,825

Sources: Compiled by author from country-level ASTI survey data and several secondary resources (see individual ASTI Country Notes); World Bank 2007 and 2011a; USDA–CRS 2011; USDA–ERS 2011; and FAO 2011.

Notes: Data presented are for the latest year available. FTE indicates full-time equivalents; PPP indicates purchasing power parity.

<sup>a</sup>. Data are for 32 SSA countries only, representing 10,499 FTE researchers and 1,575 million 2005 PPP dollars in 2008.

<sup>b</sup>. Data on researchers exclude technicians and support-staff who may also hold postgraduate degrees.

Agricultural research systems in most SSA countries are characterized by low capacity and vulnerability to funding volatility. Of a sample of 32 countries surveyed by the Agricultural Science and Technology Indicators (ASTI) initiative in 2009–10, eight of the larger countries have driven recent growth in the performance of agricultural research, accounting for two-thirds of investment and capacity during the 2001–08 period.<sup>2</sup> With the exception of these eight, almost all of the remaining countries in SSA each invest less than \$25 million purchasing power parity (PPP) dollars per year in

<sup>1</sup>Data on the number of agencies are based on 32 SSA countries only; these countries account for more than 90 percent of the region’s agricultural GDP.

<sup>2</sup>The eight countries are Ethiopia, Ghana, Kenya, Nigeria, South Africa, Sudan, Tanzania, and Uganda.

agricultural research and employ fewer than 300 full-time equivalent (FTE) researchers.<sup>3</sup> Nevertheless, the diversity of agroecosystems, crop preferences, and farming systems in SSA places considerable demands on small research systems and requires that researchers have an advanced level of technical expertise, yet with a multidisciplinary background. Only one-third of SSA researchers, however, are qualified to the PhD-degree level, whereas three-quarters of Indian researchers and all of American researchers are PhD-qualified. India and the United States also employ a number of technicians and support staff with postgraduate degrees, but this is true in only a few SSA countries.

Given the investment and capacity constraints in SSA, regional research networks and subregional organizations (SROs) have been promoted to strengthen research efforts, create synergies, and encourage spillovers. SROs have grappled with the problem of country buy-in and funding, but have gradually secured regional cooperation around the Comprehensive Africa Agriculture Development Program (CAADP) of the New Partnership for Africa's Development (NEPAD) and the Framework for African Agricultural Productivity (FAAP). The Forum for Agricultural Research in Africa (FARA) is coordinating implementation of FAAP with three SROs: the West and Central African Council for Agricultural Research and Development (CORAF/WECARD), the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), and the Food, Agriculture, and Natural Resources (FANR) Directorate of the Southern Africa Development Community (SADC).<sup>4</sup> These SROs have emerged as key intermediaries for regional initiatives targeting agricultural research. Nevertheless, the ability of small systems to benefit from participation in these networks and organizations is questionable.

This paper provides a review of some of the challenges small countries face in conducting agricultural research, particularly in terms of investment levels, institutional arrangements, capacity, and sources of funding. Some policy developments that may have implications for small countries are also discussed, along with recent developments in agricultural research in some of the smallest countries in the region.

## **2. THE CHALLENGES SMALL COUNTRIES FACE IN CONDUCTING AGRICULTURAL RESEARCH**

Small research systems are often limited in their ability to take advantage of economies of scale and scope, in terms of the baseline fixed costs required to run and maintain research facilities on the one hand, and the range of research activities an agency is able to undertake, on the other. Given that each area of research requires a certain level of resources to remain viable, small systems are limited in their ability to diversify. Obviously, if resources are spread too thinly the quality of research suffers. Small countries must often focus on applied research, because they lack the resources to be able to conduct basic research (Eyzaguirre 1996).

For small countries with little comparative advantage in global markets, constraints to scaling up research correspond to the difficulties of scaling up agricultural production. Resource-rich countries have less need to develop their agricultural sectors, whereas agriculture-dependent economies usually do not diversify, so the focus on a few export or staple crops increases vulnerability to price and production shocks. Market access is often low in small countries, and environmental constraints high, which tends to lessen the adoption and potential return of new technologies, and requires greater investment per hectare (Eyzaguirre 1996). Smaller countries often have higher ratios of agricultural R&D

---

<sup>3</sup> PPPs reflect the purchasing power of currencies more effectively than do standard exchange rates because they compare the prices of a broader range of local—as opposed to internationally traded—goods and services. The use of FTEs reflects that researchers may not spend all of their time on research. For example, a professor with teaching duties who spends 25 percent of his or her time on research would represent 0.25 FTEs.

<sup>4</sup> FANR-SADC recently established the Centre for Coordination of Agricultural Research and Development in Southern Africa.



expenditure to agricultural output (AgGDP), given the higher levels of investment needed to maintain national research agencies despite a lower contribution by the agricultural sector to the economy.

It can be difficult for small institutions to maintain the required core staff capacity to ensure programmatic and operational continuity, once again restricting the scope of research. Furthermore, when the pool of trained agricultural researchers is small, opportunities for training and advancement limited, and government salaries uncompetitive, resulting high turnover and “brain drain” can critically erode a research agency’s ability to function. In low-income countries, pressing requirements for trained personnel across all sectors make it difficult to prioritize agricultural training over other sectors, such as health and education (Eyzaguirre 1996). Decisions on staffing can have long-term effects on agency sustainability. Research agencies’ budgets are mostly directed toward salaries, and when budgets are constrained or cut, tough decisions must be made on how to manage payrolls. Salaries that do not keep pace with inflation are a leading cause of high staff turnover. Hiring freezes are a common method of reducing staff costs, often resulting in an aging staff population. Once the hiring freeze is lifted, a significant gap exists between the new junior staff and the aging (often retiring) senior staff in terms of qualifications and experience (Beintema and Stads 2011).

Lack of in-country degree programs can also pose a challenge to capacity in small countries because scientists must go abroad for training, which is a significant, and expensive, commitment. Universities in small countries often do not offer postgraduate programs or have very limited types of training. In some countries, researchers can take advantage of universities in larger neighboring countries. Botswana and Namibia, for example, send many students to South Africa. But for some small countries language is a barrier; researchers from Rwanda, Burundi, and Mozambique, for example, would have to travel further to attend a degree program offered in French or Portuguese. Costs for higher agricultural training abroad can be high, particularly in the United States and Europe. Overseas training can be dependent on donor funding; can contribute to brain drain, given that many students do not return home once they become qualified; and such programs can be less relevant to the agricultural needs of researchers’ own countries. So-called sandwich programs, which allow joint study at a national university as well as a university abroad, have become a more attractive option for many countries in the past decade (Eicher 2004), but these programs still require sufficient faculty staff to oversee the training.

Small research agencies and university faculties are particularly vulnerable to funding fluctuations. The completion of a large donor-funded project can have a severe effect on an agency’s sustainability (Eyzaguirre 1996). An influx of donor funding can lead to staffing levels that become difficult to maintain once the project is over. In addition to volatility, dependence on donor funding can also affect the direction of research priorities. Completion of donor-funded research projects may take precedence over other core mandates. Competitive grant mechanisms are an emerging source of funding for agricultural research in many countries, but such mechanisms are also generally donor-driven and vulnerable to funding volatility. In several SSA countries, these types of grant schemes were not sustained after the end of the project.

Given these capacity and funding challenges in small countries, institutional arrangements and structures can play a critical role in ensuring the effectiveness of research. However, guidance on optimal policy and institutional configurations for research agencies is thin (Hall and Yoganand 2004; Ragasa et al. 2010). Most research systems have developed through trial and error, going through intermittent reorganizations to address particular limitations or as the result of political objectives (Roseboom, Pardey, and Beintema 1998). In the past, some of the most common areas of reform in SSA involved research and extension linkages, the creation of a coordinating body to manage agricultural research, the creation or dissolution of autonomous or semiautonomous commodity-specific research agencies, granting semiautonomous status to the main national agricultural research institute, and changing responsible line ministries for the research agencies and agricultural universities.

A cross-cutting issue for the effectiveness and viability of small-country agricultural research systems is the overall policy environment. One development in the past decade in SSA is that science, technology, and innovation have come to the fore as areas of interest and investment. Many countries have recently established ministries or councils for science and technology (S&T), demonstrating a new level of political commitment to the area. The ability of these ministries or councils to coordinate research varies considerably, however. So far, the effect on the organization of agricultural S&T has been negligible in small SSA countries, but these agencies may play a larger role in the future.

Small countries in SSA potentially have much to gain from greater regionalization. Regional economic communities in Africa have gradually strengthened over the past decade as member countries move toward greater regional market integration based on areas of mutual interest, such as the harmonization of tariff structures and large-scale regional infrastructure projects. The agricultural research SROs (ASARECA, CORAF/WECARD, and SADC-FANR) have also gained prominence under CAADP and the umbrella of FARA. As CAADP's strategy for advancing agricultural research, technology dissemination, and adoption, FAAP emphasizes three themes: institutional reform, increased investment, and funding harmonization (FARA 2006).

Donors are making efforts to coordinate programs in support of FAAP with FARA and the SROs. For example, the United Kingdom's Department for International Development funds agricultural research training through the Strengthening Capacity for Agricultural R&D in Africa project, which is in turn coordinated by FARA, and implemented by the SROs. Another example is the competitive grant system coordinated by ASARECA and funded by various donors.

One of the largest sources of finance for agricultural research in SSA is the World Bank, which has also taken a regional approach. As the World Bank notes (2009: 1):

Currently, regional approaches represent only about 1 percent of the overall expenditure on agricultural research in Sub-Saharan agriculture (roughly US\$25 million per year of the total US\$2.5 billion spent per year on agricultural research and extension). The Framework for African Agricultural Productivity (FAAP) calls for increasing the level of investment in regional approaches 20-fold in order to arrive at a level of US\$500 million annually within 10 years.

Two large subregional based programs, the Eastern Africa Agricultural Productivity Program (EAAPP) and the West Africa Agricultural Productivity Program (WAAPP) have already begun operations, with a similar program proposed for Southern Africa. The programs are implemented by the respective SROs, ASARECA, and CORAF/WECARD, and are funding subregional centers of excellence for particular crops and commodities—for example, maize in Ethiopia, dairy in Kenya, roots and tubers in Ghana, and rice in Mali.

These regional programs mark a change in approach by the World Bank in terms of financing agricultural research in SSA. A decade ago agricultural research was usually funded by country-specific projects targeting capacity building and research infrastructure. With the shift in many countries to sectorwide approaches, agricultural R&D was then subsumed under a broader agricultural program, accounting for a smaller share of overall funding as other agricultural concerns took precedence. Now with the subregional approach, certain research agencies are experiencing an influx of investment toward commodities deemed both subregional and country-level priorities. So far, these subregional programs have not directly funded research in the smaller countries of SSA, but in 2011 a number were selected for the next phase of WAAPP, including Benin, Liberia, Sierra Leone, The Gambia, and Togo. It is also important to note that the World Bank's funding continues to be delivered bilaterally, despite the subregional nature of the programs.

This subregional approach has been supported by evidence of potential spillover effects. While the spillover of agricultural research outputs produced by developed countries have been significant, future benefits may be much more limited given intellectual property protection, technological gaps,

and shifts in research focus (Pardey and Pingali 2010). Subregional spillovers are currently minimal but should take on more importance as the regional economic communities seek to integrate more closely. The alignment of regional priorities with national interests could generate significant spillovers for the innovating country, as well as neighboring countries. For example, a study on East and Central Africa estimated that the benefits to the region from R&D that generated an increase in productivity of 1 percent in Kenya, Tanzania, and Uganda would be \$36 million per year, with an additional \$20 million potentially from the spillover effect of regional research cooperation (Omamo et al. 2007). West Africa could likewise benefit from such regional research initiatives, particularly in addition to other regional integration efforts that promote infrastructure, markets, and trade (Nin-Pratt et al. 2011). Despite the diversity of agroecosystems, many traverse national boundaries. Other institutional barriers, such as language and human resource capacity, may be more of a constraint to research than environmental aspects.

The challenge for small countries in SSA will be how to benefit from subregional spillovers. A number of research networks have developed over the past few decades around specific commodities both within and outside the framework of the SROs. One of the difficulties faced by small research institutes is the ability to participate in such networks given that the demands on researchers' time can be many, particularly when researchers are few. Networks have associated opportunity costs in terms of time and management (Eyzaguirre 1996).

In the 1990s, the International Service for National Agricultural Research (ISNAR) conducted a long-term study to gather data on the scale and scope of agricultural research in small countries. It identified a number of common characteristics and challenges affecting agricultural research in these countries, and explored strategies for organizing and managing research portfolios. The findings overturned the conventional wisdom (Table 2).

**Table 2. Lessons from a small-country study**

<b>The conventional wisdom on small countries</b>	<b>Findings from the study</b>
Small countries have fewer organizations involved in research	Small countries have diverse institutional actors that together constitute the national agricultural research system
Disparate research activities should be consolidated in a single organization	Consolidation into one organization is often not advisable: an effective scale of research is built on diversity
Given limited resources, small-country national agricultural research systems should narrow their scope to cover fewer areas	Narrowing the scope of national research is difficult given policy demands and changes in the agricultural and natural resource sectors
Small countries will be "technology borrowers" that do not require scientists with high-level training	Intelligent use of external knowledge requires a sophisticated scientific research capacity that can relate local needs to available technology
Small-country research systems carry out fewer and less complex functions	The smaller the system, the more complex the functions it will perform; instead of doing fewer things, small-country national agricultural research systems should do things differently; they need to emphasize a broader set of functions
Research in small countries is either vulnerable or not viable because it cannot break its dependence on donors and external agencies	All research is increasingly done in networked and interdependent modes; small countries can take a more active role in managing partnerships with donors and other external agencies

Source: Eyzaguirre 1996: 191.

Small-country agricultural research systems were generally thought of as vulnerable and unviable, lacking both capacity and resources. The recommended solution to such constraints was a consolidated research institution of limited research scope focused primarily on the adoption and adaptation of borrowed technology. Data and case studies undertaken as part of this study, however,

have provided a different picture of the capabilities and potential of small research institutions. Research in small countries is conducted by a diverse group of institutions and such diversity does not necessarily hinder effectiveness. Given the primary role of the agricultural sector in many of these countries, and the environmental challenges faced, limiting the scope of research is not usually an option. Agricultural researchers in small countries require a broad range of advanced technical skills. While a greater degree of technical specialization can take place in larger countries, small-country institutions and researchers must be more adaptable and flexible to address the complex challenges of the agricultural sector (Eyzaguirre 1996).

### 3. AGRICULTURAL RESEARCH IN THE “SMALLEST OF THE SMALL”

As noted, eight countries account for about two-thirds of all agricultural research investment and capacity in SSA. Of the remaining 24 countries, each accounted for investment of less than \$25 million PPP dollars annually, and employed fewer than 300 FTE researchers. Half of those countries employed fewer than 100 FTE researchers and/or spent less than \$10 million PPP dollars (in 2005 constant prices) annually on agricultural R&D. Most of these countries are also small in terms of population, having less than 10 million people. These “smallest of the small” countries, which employ fewer than 100 FTE researchers and spend less than \$10 million PPP dollars annually, include Burundi, the Republic of Congo, Gabon, The Gambia, Mauritania, Sierra Leone, and Togo.<sup>5</sup> These seven countries vary considerably in terms of levels of investment and capacity (Table 3). The number of researchers in the group ranges from the smallest, The Gambia with 38 FTEs, to Burundi with 98 FTEs. Burundi, with expenditures of \$9.6 million dollars in 2008, also spent the most on agricultural R&D in comparison with Gabon, which spent only \$1.6 million (both in constant 2005 PPP).

**Table 3. Overview of the smallest countries, 2008**

Country	Income group	Population (Million)	Agricultural researchers (FTEs)	Agricultural R&D spending (Million 2005 PPP dollars)	Agricultural R&D spending as a share of AgGDP (%)	Number of agricultural researchers per agricultural labor force (FTEs per million)	Postgraduate share of research staff (%)	Donor funding share (of major government agencies) (%)
Burundi	L	8.1	98	9.6	1.78	27	74	40
Congo, Rep. of	LM	3.6	94	4.6	0.85	192	98	na
Gabon	UM	1.4	61	1.6	0.20	325	76	na
Gambia, The	L	1.7	38	2.5	0.50	65	68	8
Mauritania	L	3.2	74	6.4	1.16	107	90	28
Sierra Leone	L	5.6	67	5.9	0.31	52	80	14
Togo	L	6.5	63	8.7	0.47	45	93	10

Sources: Compiled by author from country-level ASTI survey data (see individual ASTI Country Notes), World Bank 2011a, and FAO 2011.

Note: L indicates low-income country; LM, lower middle-income country; and UM, upper middle-income country.

Looking beyond absolute values, investment and capacity data can be compared with other factors to generate a clearer picture of a country’s commitment to public agricultural R&D. Agricultural R&D spending as a share of agricultural output (AgGDP) is one such measure. Only two of the smallest

<sup>5</sup> A number of other countries in SSA, such as Cape Verde, Lesotho, and Swaziland, would also fall into this category, but recent data were not available.

countries, Mauritania and Burundi, met NEPAD’s target of investing at least 1 percent of AgGDP in agricultural R&D in 2008. However, the high intensity ratios in both countries reflect relatively low AgGDP, rather than high levels of investment in agricultural R&D. With the exception of the Republic of Congo, the remaining countries all had lower ratios than the SSA average of 0.61.

Another intensity ratio, the number of agricultural researchers compared with the agricultural labor force, offers another way of assessing a country’s commitment to agriculture. With few people employed in the agricultural sector, Gabon has a very high number of researchers to agricultural laborers (325), whereas Burundi, which has a much larger population, has significantly fewer (27). Gabon’s low spending intensity (0.20) alongside its high researcher intensity indicates that researchers’ access to resources is low compared with other countries. Three other upper middle-income countries with similar populations have significantly higher spending intensities based on higher investment levels as a share of AgGDP: Botswana (4.32), Mauritius (3.92), and Namibia (2.03). Each of these countries spends around 20 million dollars annually on agricultural research (in 2005 constant PPPs) in contrast to Gabon’s 1.6 million.

### Institutional Structures

Given the importance of scale and scope in determining the effectiveness of research, smaller countries might be expected to have more closely coordinated research institutions, focused on just a few key agricultural areas. However, similar to the findings in the ISNAR study of the early 1990s, the smallest countries have a relatively large number of agencies and extensive scope of research, despite having so few agricultural researchers. The number of government, nonprofit, and higher education agencies involved in agricultural research ranges from 3 in Sierra Leone to 16 in the Republic of Congo (Table 4). Only Burundi has an agency employing more than 50 FTE researchers (Figure 1). However, main government agencies often administer and coordinate a number of associated research centers at locations throughout the country, which has implications for research management, expenditures, and collaboration. The level of fragmentation of research is not only a factor of the number of agencies and centers, but also of the effectiveness of the directorate or coordinating body and the resources available. Scope of research may also be constrained by these factors, but data on research focus reveal that the smallest countries conduct research on a wide variety of crop and livestock areas. However, other areas such as forestry and natural resources appear to be sidelined in several countries (Figure 2).

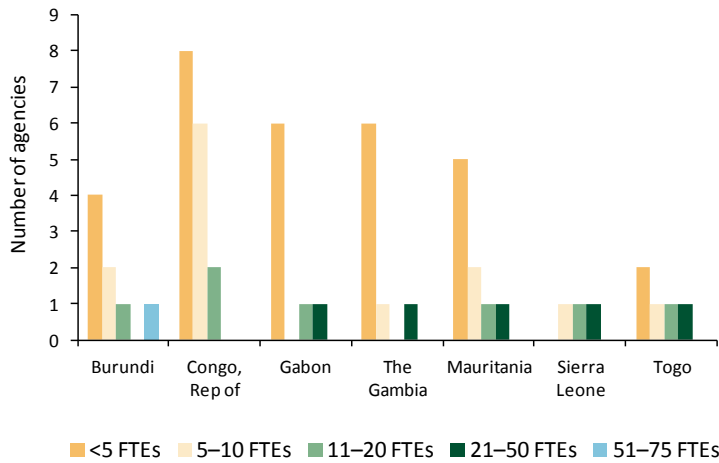
**Table 4. Number of agencies and FTE researchers involved in agricultural research, 2008**

	Number of agencies				Number of researchers (FTEs)			
	Government	Nonprofit	Higher education	Total	Government	Nonprofit	Higher education	Total
Burundi	4	0	4	8	82.0	0	15.8	97.8
Congo, Rep of	12	2	2	16	70.5	8.5	14.8	93.8
Gabon	4	1	3	8	55.0	1.2	5.3	61.4
Gambia, The	6	0	2	8	35.7	0	2.0	37.7
Mauritania	4	1	4	9	62.4	0.3	11.0	73.7
Sierra Leone	1	0	2	3	53.0	0	18.6	71.6
Togo	1	1	3	5	41.0	0.6	21.1	62.7

Source: Compiled by author based on country-level ASTI survey data (see individual ASTI Country Notes).

Note: Semiautonomous agencies are counted separately and include institutes, faculties, and departments that may be housed within a larger center or university.

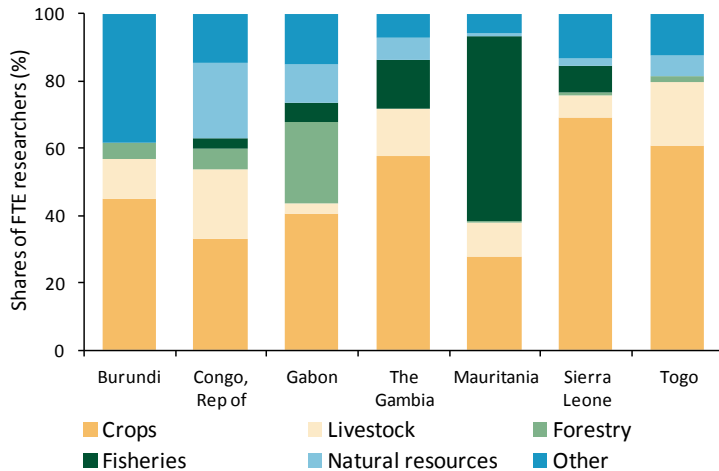
**Figure 1. Size distribution of research agencies, 2008**



Source: Compiled by author based on country-level ASTI survey data (see individual ASTI Country Notes).

Note: Semiautonomous agencies are counted separately and include institutes, faculties, and departments that may be housed within a larger center or university.

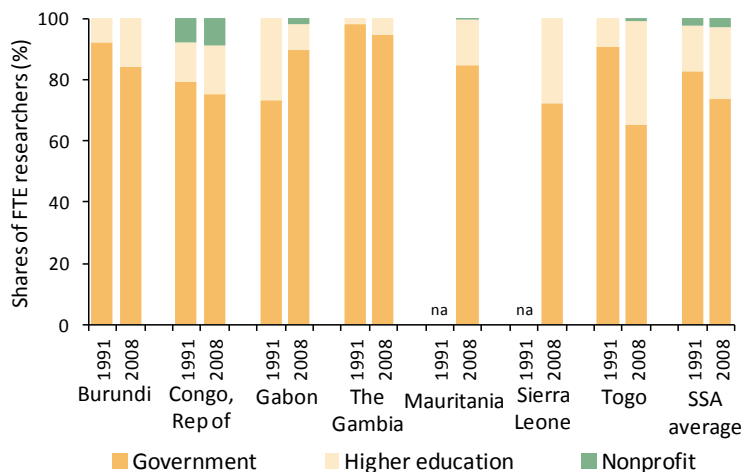
**Figure 2. Agricultural researchers by major sector, 2008**



Source: Compiled by author based on country-level ASTI survey data (see individual ASTI Country Notes).

One common feature of the institutional structure of agricultural research across SSA is the growing role of higher education agencies, and the concurrent limited role of the nonprofit and private sectors (Beintema and Stads 2011). The smallest countries follow this trend, with the exception of Gabon, whose government sector has grown more rapidly while the number of faculty staff has decreased. Although shares of university researchers have increased since 1991, given the few researchers in the smallest countries, these increases may have a negligible effect on the overall level of research undertaken (Figure 3). For example, The Gambia employed only 2 FTE researchers in the higher education sector in 2008; Gabon had 5. In contrast, Togo’s 21 FTE researchers, one-third of the country’s total number, reflect the strong contribution to agricultural research made by the University of Lomé. Universities can play an important role in small-country agricultural research systems. In another neighboring small country, Benin, faculty staff account for 40 percent of the country’s total agricultural research staff.

**Figure 3. Agricultural researchers by institutional category, 1991 and 2008**



Source: Compiled by author based on country-level ASTI survey data (see individual ASTI Country Notes).

Note: Data for Mauritania and Sierra Leone was not available for 1991.

Despite employing the fewest number of researchers among the smallest SSA countries for which data were available, The Gambia had a high number of government agencies involved in agricultural research. Of six government agencies, the National Agricultural Research Institute (NARI) is the largest, employing 25 FTE researchers in 2008. However, the other five agencies employed 1–5 FTE researchers in the areas of fisheries, nutrition, water, and livestock. NARI itself oversees four laboratories and several satellite research stations countrywide. NARI’s 25 FTE researchers focus on a wide range of research topics from crops, such as rice, maize, groundnuts, millet, fruits, cassava, to livestock, such as beef and dairy cattle, sheep and goats, swine, and poultry. Despite NARI’s mandate to undertake forestry, fisheries, and natural resources research, with so few researchers and a lack of funding, the Institute is unable to do so and hence focuses only on crops and livestock. Forestry research is therefore neglected, and fisheries and natural resources issues are only minimally addressed by the other agencies. As mentioned, The Gambia’s higher education agencies only contribute 2 agricultural FTE researchers, whose research activities can best be described as ad hoc.

Mauritania’s crop and livestock researchers are also spread thinly. A majority of government researchers are based at one agency focusing on fisheries, the Mauritanian Institute of Oceanographic Research and Fisheries (IMROP). At two other government agencies, only 8 FTE researchers attend to livestock research, including beef and dairy cattle, camels, sheep and goats, and poultry, while 18 FTE researchers focus on crop areas, such as rice, vegetables, fruits, sorghum, and maize.

Burundi’s main government agency, the Burundi Institute of Agronomic Sciences (ISABU), employed 63 FTE researchers in 2008, two-thirds of the country’s total. The agency had, however, employed 150 FTE researchers prior to the civil war that began in 1993. From 1994 to 2006, the Institute employed no more than 50 FTEs, but despite both investment and capacity constraints, it operates 6 agricultural experiment stations, 10 research centers, and 6 research units, with a research program developed around four thematic areas: crops, livestock, farming systems, and rural socioeconomics. Crop research predominates at ISABU, focusing primarily on coffee, potatoes, vegetables, fruit, maize, cassava, wheat, soybeans, and tea, and to a lesser extent on rice, sorghum, macadamia nuts, and sweet potatoes. Livestock research focuses on beef cattle. A smaller government agency and the universities conduct research in other areas related to livestock.

Almost all of the Republic of Congo’s research centers fall under a single supervising agency, the General Delegation of Scientific and Technical Research (DGRST); however, they operate with a degree

of autonomy. The 11 centers employ 68 FTE researchers in total, most with fewer than 5 FTE researchers each. The livestock and crop centers are the largest, employing 18 and 14 FTE researchers, respectively. Livestock research areas include poultry, sheep and goats, beef, and swine. Crop research focuses on cassava, fruits, vegetables, and maize, but other crops are also the subject of research, including groundnuts, rice, soybeans, yams, sugarcane, potatoes, and oil palm.

Sierra Leone's research is coordinated by one government agency, the Sierra Leone Agricultural Research Institute (SLARI). The country's research agencies were devastated by the civil war and are still in a process of rebuilding. SLARI is expected to oversee eight research centers, but only two are fully operational, while two others are partly operational. The majority of the country's 53 FTE government researchers focus on crops—particularly rice and cassava—but also sorghum, yams, groundnuts, sweet potatoes, cowpeas, maize, coffee, cocoa, vegetables, oil palm, coconut palm, and sesame. Livestock research is minimal, involving just 7 percent of researchers. With the fisheries research center not yet established, fisheries research is only being conducted by the universities.

As noted, Togo has the highest number and share of higher education researchers among this group of countries. The government research agency, the Togolese Agricultural Research Institute (ITRA) is not faring as well as the University of Lomé, however. Capacity has declined since its 1997 establishment to 41 FTE researchers in 2008. ITRA's research mandate includes agricultural systems, crops, livestock, fisheries, natural resource management, and food technology. The Institute also oversees several agricultural research centers located across the country. Crop research predominates, with maize the most important, followed by cotton, rice, yams, sorghum, cassava, cocoa, and coffee. Livestock research is also conducted on sheep and goats, beef, poultry, and swine. Forestry research is minimal, however, and fisheries research nonexistent.

In contrast to the preceding countries, Gabon's oil wealth makes its economy less dependent on the agricultural sector; this is reflected in the low priority the government assigns to agricultural research. Although the number of public agricultural researchers increased considerably from 1990s levels, government funding has been low and erratic. While a central agency—the National Scientific and Technological Research Center (CENAREST)—coordinates research, its three agricultural research agencies are semiautonomous. The largest agency, the Agricultural and Forestry Research Institute (IRAF), employed 34 FTE researchers in 2008 and is responsible for research on crops, livestock, forestry, fisheries, and socioeconomics. Its four departments each run several research units and laboratories. Crop researchers at IRAF predominantly focus on bananas/plantains, and cassava, followed by coffee and cocoa. Livestock research is a low priority compared with forestry, fisheries, and natural resources. CENAREST's two other agencies, which together employ 17 FTE researchers, focus on postharvest and forestry research.

## **Human Resources**

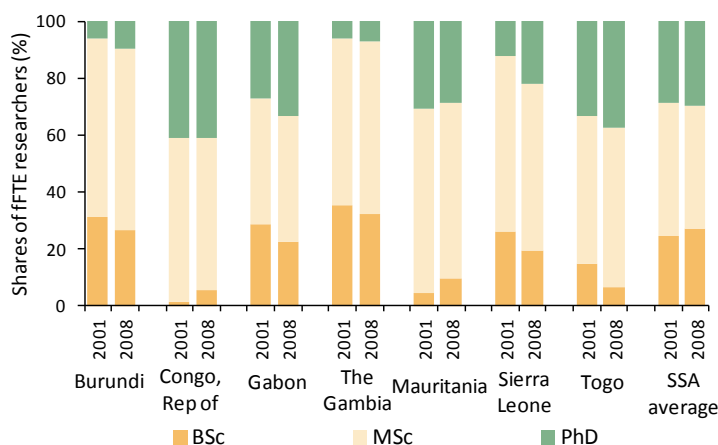
Research capacity is an important determinant of the effectiveness of national agricultural research. The hiring and training choices and investments made by research agencies are a form of priority setting for research (Tollini 1998). Managerial and technical skills are even more important to research systems in small countries, where an institution's existence can depend on the strength of leadership and expertise of its staff. Research at these smaller institutions may require a more holistic, less specialized approach. Smaller institutions can also present greater opportunities for researchers to be involved in strategic decisionmaking (Ezyaguirre 1996). The added complexity of small-country research means that researchers should be well-qualified and have a broad range of skills they can adapt to different research functions.

Given the relatively low level of resources devoted to agricultural research in the smallest SSA countries, capacity challenges are significant, particularly at the government agencies. The challenges



are not the same in each country, however. Levels of qualifications vary considerably across the countries (Figure 4). The Republic of Congo and Togo had the highest shares of PhD-qualified researchers in 2008, at 41 and 38 percent, respectively; correspondingly, these two countries also had the lowest shares of researchers qualified to the BSc level (6 and 7 percent, respectively). Gabon and Mauritania's shares of researchers with PhD degrees were close to the average for SSA, at around 30 percent in 2008; the lowest shares of researchers with PhD degrees were recorded in The Gambia and Burundi (7 and 10 percent respectively).

**Figure 4. Agricultural researchers by degree qualification, 2001 and 2008**



Source: Compiled by author based on country-level ASTI survey data (see individual ASTI Country Notes).

Generally, researchers are more likely to be qualified to the PhD-degree level in the higher education sector than in the government and nonprofit sectors, and this is also true for the smallest countries. Strong university programs are imperative for training the next generation of agricultural scientists. However, a limited number of MSc programs in the agricultural sciences operate in the smallest countries. PhD programs are absent, with the exception of the Republic of Congo and Togo (technically a thesis co-tutorship program between the University of Lomé and developed-country universities). Degree training for most researchers must be completed abroad, significantly increasing the costs.

The Republic of Congo, despite its high share of staff qualified to an advanced level, faces a number of capacity challenges. On a positive note, Marien Ngouabi University offers MSc and PhD training, and FARA and CORAF/WECARD programs provide grants for researchers to attain degrees. The main government agencies, however, have been operating under a 25-year hiring freeze that has led to a serious problem of aging staff, driving younger scientists to seek employment at the universities and elsewhere. Lack of research program funding has also affected the motivation of researchers employed at government agencies. Similarly, Togo has an aging pool of researchers due to limited recruitment. Lack of training opportunities and more attractive conditions at the universities are also contributing to a gradual erosion of capacity at Togo's main government agency.

In contrast to the Republic of Congo and Togo, Gabon's researchers are quite young, averaging 30 years old. Motivation is also an issue, however, due to a lack of facilities, research program funding, and potential for career advancement.

The Gambia and Burundi's main government agencies, NARI and ISABU, are significantly constrained by their lack of PhD trained staff. The two agencies each employed only 2 PhD-qualified FTE researchers in 2008. Burundi's researchers are also limited in their ability to take advantage of training opportunities in neighboring countries due to the language difference.

The fisheries subsector overshadows crops and livestock in Mauritania, and research capacity reflects this. Researchers at the fisheries research agency, IMROP, are also more likely to hold PhD degrees than are those employed at the crop and livestock research agencies, where opportunities are generally more limited, and the problem of aging staff is prevalent. IMROP’s funding advantage has allowed the Institute to maintain a well-trained pool of researchers since 2001.

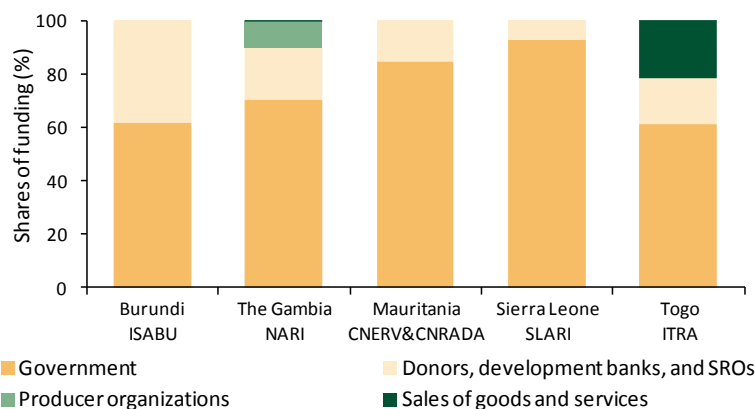
Sierra Leone’s research capacity was greatly eroded during the civil war, and as a result includes few researchers with PhD degrees. A gap now exists between the older, senior researchers who returned after peace was restored, and the younger, inexperienced researchers hired more recently. As mentioned, only two of eight SLARI research centers are fully operational, so capacity and training challenges will persist for the foreseeable future.

### Financial Resources

The scope and scale of research can be expanded or constrained by financial resources. Small agricultural research agencies in SSA tend to be financially vulnerable. With limited government resources, salaries constitute the bulk of expenditures, and operating costs and capital investments by necessity have less priority and are the first to be cut. Donors and development banks usually provide the funding for the operating and capital costs of research rather than on salaries but often have particular priorities that may influence the agenda of research agencies.

Average donor and development bank funding for the main government agencies of the smallest countries ranged from a low of 8 percent in Sierra Leone, to 40 percent of total funding in Burundi (Figure 5). NARI in The Gambia and ITRA in Togo also generated some revenues from the sale of goods and services. NARI, however, received significantly more funding from producer organizations. No other main government agency in this group received producer organization or commodity levy funding.

**Figure 5. Funding sources of main government agencies, average 2001–08**



Source: Compiled by author based on country-level ASTI survey data (see individual ASTI Country Notes).

Note: Data for Gabon and the Republic of Congo were not available. Mauritania funding data are for 2004–08 only.

Donor and development bank funding in the smallest countries tends to be targeted toward particular crops or major commodities, such as fisheries in Mauritania. Many of the rice-growing countries of West Africa, such as Sierra Leone, The Gambia, and Togo, have benefitted from the African Development Bank–financed New Rice for Africa (NERICA) project led by the Africa Rice Center.

Since the end of the civil war in Sierra Leone, researchers’ salaries, other recurrent costs, and the rehabilitation of agencies damaged in the civil war have all been funded by the government; however, the funding provided usually meets only half of SLARI’s yearly request, slowing the pace of reconstruction. Donors gradually returned to funding research since 2007, but levels have been

relatively low. In addition to NERICA, another major project, the World Bank–financed Rural and Private Sector Development Project (RPSDP) has been focused on improving cocoa and coffee varieties. Sierra Leone is included in Phase 1C of the WAAPP and is likely to receive an influx of agricultural research funding in the next few years, in particular to establish a regional center of excellence for mangrove rice. The goal of WAAPP is to advance technology generation, dissemination, and adoption in the region and to lay the groundwork for greater market integration (World Bank 2011b).

The Gambia and Togo are also included in Phase 1C of the WAAPP, although funding will not be directed to centers of excellence, but to strengthening capacity for research and technology transfer. Given the relatively low levels of agricultural research investment in both countries, NARI and ITRA will most likely benefit from increased funding through this program. Nevertheless, previous experience with World Bank–financed projects in both countries offers some cautionary lessons. Investment levels were much higher in the 1990s than after 2000, but were also quite erratic. This funding in the early 1990s originated primarily from World Bank–financed projects that could not be sustained thereafter. Although the governments of both countries subsequently increased agricultural research funding to counteract some of the shortfall (and the agencies generated some additional revenues), it has been insufficient to maintain capacity at previous levels. In addition, a competitive grant program begun through the project in The Gambia was not maintained. Careful planning and use of WAAPP funds will be needed to avoid repetition of the negative consequences of sharply contracting funding at the end of the project.

Mauritania’s main crop and livestock research agencies were also severely affected by the end of a World Bank–financed program in 2000, causing them to lose many senior staff in the process. In contrast, a 2002 trade treaty on fisheries with the European Union contributed significantly to funding inflows to IMROP. However, investment levels in Mauritania were the most volatile of any country in SSA, due to both donor and government funding fluctuations.

In contrast to Sierra Leone, rehabilitation of agencies in another postconflict country, Burundi, has been financed through World Bank and Belgian Development Agency projects. Burundi also receives support from a number of other donors. This funding has allowed the country to re-establish its agencies at a slightly faster pace than Sierra Leone, although levels have yet to return those recorded in the early 1990s. EAAPP is currently only supporting centers of excellence in the larger countries of East Africa—Ethiopia, Kenya, Tanzania, and Uganda—so the smaller countries of the region are unlikely to receive funding from the program in the short term. ASARECA, however, provides competitive grant funding that agencies are eligible to apply for. ASARECA operates a number of regional research programs centered on particular commodity and thematic areas: staple and nonstaple crops, livestock and fisheries, agrobiodiversity and biotechnology, natural resource management and forestry, policy analysis and advocacy, and up-scaling and knowledge management (ASARECA 2011).

Unfortunately, detailed funding data for Gabon and the Republic of Congo were not available. In general, both countries receive limited support from donors, whose focus tends to be directed to less wealthy neighboring countries. Gabon’s donors include the Food and Agriculture Organization of the United Nations, the European Union, and the Japan International Cooperation Agency. The Republic of Congo receives financing from the World Bank, African Development Bank, and International Fund for Agricultural Development for agricultural development projects that include research components; the country also receives funding for short-term projects through a variety of other donors. Despite the small scale of this funding, such projects are critical to the research being conducted in the countries. Aside from funding researcher salaries, the governments contribute very little toward the operating and capital costs associated with research programs, and this seriously limits the performance of research in both countries.

#### 4. CONCLUSION

The experiences of the “smallest of the small” countries in SSA reinforce the conclusions of the earlier ISNAR study. Recent data from seven of the smallest countries in SSA illustrate the diversity of agricultural research systems in these countries. Cross-country institutional structures, investment levels, capacity, and funding mechanisms can vary considerably despite some common challenges. Notwithstanding the small size of these countries, investment and capacity levels are uniformly low. Yet focusing solely on increasing investment and capacity levels is not enough to ensure effective agricultural research agencies. Policy, institutional, and organizational constraints must also be addressed, including strengthening national S&T policies and strategies; developing consistent funding mechanisms; training and incentivizing researchers; and managing links among extension services, farmers, policymakers, and other researchers.

Despite challenges, small-country research systems in SSA should not be considered unviable. World-class research programs can be found in several small countries—for example, Mauritius and Trinidad and Tobago. Small countries may not be able to take advantage of economies of scale and scope, but their small size can also be an advantage in terms of facilitating greater flexibility. As Ezyaguirre (1996) points out, small research systems must find ways to adapt to the constraints they face through innovative institutional arrangements. There are no “one size fits all” models, however. Given the diversity of agricultural production systems, the research system that emerged in Mauritius may not be suitable for a country like Mauritania. Policy and management approaches relating to priority setting and allocating resources must be adjusted to meet each country’s needs. Determinants of the effectiveness of agricultural research agencies, and linkages with performance outcomes, are areas in need of further research.

With the implementation of the regional approach to agricultural R&D in SSA, a shift in resource allocation may occur. An influx of funding toward priority crops may once again create a boom and bust situation for certain research agencies. With proper management, however, the funding could build a foundation for high-quality research, while freeing funds for other research priorities. Well-functioning research and extension systems that address the needs of the agricultural sector can provide high rates of return to investment, even in the small countries. Such systems are essential for a modernized productive agricultural sector that contributes to economic growth and poverty reduction in these countries. The question is whether SSA’s small countries will make the necessary commitments to strengthen efforts to advance agricultural research.

## REFERENCES

- ASARECA (Association for Strengthening Agricultural Research in Eastern and Central Africa). 2011. ASARECA Regional Programmes. <<http://www.asareca.org/index.php?page=programmes&a=27>>. Accessed September 7, 2011.
- Beintema, N., and G. J. Stads. 2011. *African Agricultural R&D in the New Millennium: Progress for Some, Challenges for Many*. IFPRI Food Policy Report. Washington, DC: International Food Policy Research Institute.
- Eicher, C.K. 2004. *Rebuilding Africa's Scientific Capacity in Food and Agriculture*. Staff Paper 2004-12. East Lansing, Michigan: Department of Agricultural Economics, Michigan State University.
- Eyzaguirre, P. 1996. *Agriculture and Environmental Research in Small Countries: Innovative Approaches to Strategic Planning*. Chichester: John Wiley & Sons.
- FAO (Food and Agriculture Organization of the United Nations). 2011. FAOSTAT Database. <<http://faostat.fao.org/site/452/default.aspx>>. Accessed September 8, 2011.
- FARA (Forum for Agricultural Research in Africa). 2006. *Framework for African Agricultural Productivity*. Accra.
- Hall, A. J., and B. Yoganand. 2004. New Institutional Arrangements in Agricultural Research and Development in Africa: Concepts and Case Studies. Chapter 4 in Hall, A. J., B. Yoganand, R. V. Sulaiman, R. Raina, S. Prasad, G. Niak, and N. G. Clark (eds.) *Innovations in Innovation: Reflections on Partnership and Learning*. Patancheru and New Delhi: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and National Centre for Agricultural Economics and Policy Research (NCAP).
- Nin-Pratt, A., M. Johnson, E. Magalhaes, L. You, X. Diao, and J. Chamberlin. 2011. *Yield Gaps and Potential Agricultural Growth in West and Central Africa*. IFPRI Research Monograph. Washington, DC: International Food Policy Research Institute.
- Omamo, S. W., X. Diao, S. Wood, J. Chamberlin, L. You, S. Benin, U. Wood-Sichra, and A. Tatwangire. 2007. *Strategic Priorities for Agricultural Development in Eastern and Central Africa*. IFPRI Research Report 150. Washington, DC: International Food Policy Research Institute.
- Pardey, P. G., and P. L. Pingali. 2010. *Reassessing International Agricultural Research for Food and Agriculture*. Report prepared for the Global Conference on Agricultural Research for Development (GCARD), March 28–31, Montpellier, France.
- Ragasa, C., S. Babu, A. S. Abdullahi, and B. Y. Abubakar. 2010. Strengthening Innovation Capacity of Nigerian Agricultural Research Organizations. IFPRI Discussion Paper 1050. Washington, DC: International Food Policy Research Institute.
- Roseboom, J., P. G. Pardey, and N. M. Beintema. 1998. The Changing Organizational Basis of African Agricultural Research. EPTD Discussion Paper No. 37. Washington, DC: International Food Policy Research Institute.
- Tollini, H. 1998. Capital Investment Policies and Agricultural Research. In Tabor, S.R., W. Janssen, and H. Bruneau (eds.) *Financing Agricultural Research: A Sourcebook*. The Hague: International Service for National Agricultural Research.
- USDA–CRIS (United States Department of Agriculture, Current Research Information System). 2011. Selected CRIS Funding Summaries. <<http://cris.csrees.usda.gov/fsummaries.html#2008>>. Accessed September 9, 2011.
- USDA–ERS (United States Department of Agriculture, Economic Research Service). 2011. Agricultural Research Funding in the Public and Private Sectors. <<http://www.ers.usda.gov/Data/AgResearchFunding/>>. Accessed September 9, 2011.
- World Bank. 2011a. World Development Indicators (WDI) and Global Development Finance (GDF). <[http://databank.worldbank.org/ddp/home.do?Step=2&id=4&hActiveDimensionId=WDI\\_Series](http://databank.worldbank.org/ddp/home.do?Step=2&id=4&hActiveDimensionId=WDI_Series)>. Accessed September 8, 2011.

- \_\_\_\_\_. 2011b. *West Africa Agricultural Productivity Program APL (WAAPP-1C): Project Information Document*. Report No. AB6207. Washington, DC.
- \_\_\_\_\_. 2009. *Project Appraisal Document on Three Proposed Credits in the Amount of SDR 20.1 million (US\$30 million equivalent) to the Federal Democratic Republic of Ethiopia, of SDR 20.1 Million (US\$30 Million Equivalent) to the Republic of Kenya, of SDR 20.1 million (US\$30 Million Equivalent) to the United Republic of Tanzania for a Total of SDR 60.3 million (US\$90 Million Equivalent) for Eastern Africa Agricultural Productivity Program APL1 in Support of the First Phase of the Eastern Africa Agricultural Productivity Program*. Report 48295-AFR. Washington, DC.
- \_\_\_\_\_. 2007. *World Development Report 2008: Agriculture for Development*. Washington, DC.

### **ASTI Country Notes**

- Stads, G. J., and L. Ndimurirwo. 2011. *Burundi*. ASTI Country Note. Washington, DC, and Bujumbura: International Food Policy Research Institute and l'Institut des Sciences Agronomiques du Burundi.
- Stads, G. J., and K. Labare. 2010. *Togo*. ASTI Country Note. Washington, DC, and Lomé: International Food Policy Research Institute and Togolese Agricultural Research Institute.
- Stads, G. J., and F. Manneh. 2010. *The Gambia*. ASTI Country Note. Washington, DC, and Brikama, The Gambia: International Food Policy Research Institute and National Agricultural Research Institute.
- Stads, G. J., and J. Momoh. 2010. *Sierra Leone*. ASTI Country Note. Washington, DC, and Freetown: International Food Policy Research Institute and Sierra Leone Agricultural Research Institute.
- Stads, G. J. and P. Obiang-Angwe. 2011. *Gabon*. ASTI Country Note. Washington, DC, and Libreville: International Food Policy Research Institute and Agriculture and Forestry Research Institute.
- Stads, G. J., G. Bani, and A. Itoua-Ngaporo. 2010. *Republic of Congo*. ASTI Country Note. Washington, DC, and Brazzaville: International Food Policy Research Institute and General Delegation of Scientific and Technical Research.
- Stads, G. J., S. Guèye, and M. L. Dia. 2010. *Mauritania*. ASTI Country Note. Washington, DC, and Nouakchott: International Food Policy Research Institute and National Livestock and Veterinary Research Center.





INTERNATIONAL FOOD  
POLICY RESEARCH INSTITUTE  
sustainable solutions for ending hunger and poverty  
Supported by the CGIAR

2033 K Street, NW | Washington, DC 20006-1002 USA  
Tel: +1.202.862.5600 | Skype: ifprihomeoffice  
Fax: +1.202.467.4439 | Email: ifpri@cgiar.org

[www.ifpri.org](http://www.ifpri.org)



FORUM FOR  
AGRICULTURAL  
RESEARCH  
IN AFRICA

PMB CT 173 | Accra, Ghana  
Tel: +233.302.772823  
Fax: +233.302.773676 | Email: info@fara-africa.org

[www.fara-africa.org](http://www.fara-africa.org)

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.

This paper has been peer reviewed and may also have been slightly revised after the conference. Any opinions stated herein are those of the author(s) and are not necessarily endorsed by or representative of IFPRI or FARA.

Copyright © 2011 International Food Policy Research Institute and Forum for Agricultural Research in Africa. For permission to republish, contact ifpri-copyright@cgiar.org.