Research Application Summary

Agricultural Research and Higher Education in Africa: Trends, challenges and ways of moving forward[1]

Nienke Beintema
Agricultural Science and Technology Indicators (ASTI) initiative, International Food Policy Research Institute (IFPRI)
Corresponding author: N.BEINTEMA@CGIAR.ORG

Abstract

Agricultural R&D is critical to increasing smallholder productivity and generating agricultural growth in Sub-Saharan Africa (SSA), but governments continue to underinvest in agriculture, more specifically in agricultural research and development (R&D). After a decade of stagnation during the 1990s investments and human resource capacity in SSA's public agricultural R&D increased by more than 20 percent during 2001–08. Most of this growth, however, occurred in a handful of countries and was largely the result of increased government commitments to enlarge very low salaries and to rehabilitate neglected infrastructure, often after years of underinvestment. Furthermore, close to half of the SSA countries, for which time-series data were available during this period, experienced declines in their spending levels. Many countries, particularly those in francophone West and Central Africa, are threatened by extremely fragile funding systems, are highly dependent on donor funding, and face large fluctuations in funding levels from one year to the next.

Despite positive developments in agricultural R&D staffing levels in most countries, a large number of them continue to face important capacity challenges. In some countries, especially in francophone West Africa, long-term public-sector recruitment restrictions have skewed the average age of scientists to the higher end of the spectrum and left agencies vulnerable as their senior staff approach retirement without a clear line of succession. Countries that have been able to lift long-term recruitment bans have often had to contend with influxes of young, inexperienced, BSc-qualified scientists in need of

[1] This paper is based on excerpts from Beintema, N., and G.-J. Stads, *African Agricultural R&D in the New Millennium: Progress for Some, Challenges for Many*, IFPRI Food Policy Report (2011) and Lynam, J., N. Beintema, and I. Annor-Frempong. *Agricultural R&D: Investing in Africa's Future–Analyzing Trends, Challenges, and Opportunities, Reflections on the Conference* (2012). Both reports are available at http://www.ifpri.org/sites/default/files/publications/pr24.pdf and http://www.asti.cgiar.org/pdf/ASTI-FARA-Conference-Synthesis.pdf.

appropriate training but lacking middle-level mentors to guide them. Attracting and retaining qualified research staff is a major challenge. Moreover, in-country postgraduate training opportunities are limited in many countries.

The organizational architecture for SSA research is in place, but it has become highly complex, and many of the potential linkages and institutional arrangements remain underdeveloped. Building on the outputs and deliberations during the ASTI/IFPRI-FARA conference in Accra in December 2011, a number of directions were identified that are needed to address the many challenges agricultural R&D faces in SSA in terms on sustainable investments by governments and donors, development of the necessary scientific talent, creation of linkages between a diverse group of national stakeholders, and the development appropriate interfaces across global and regional agricultural research systems.

Key words: Agricultural R&D, financial resources, human resource capacity, institutional arrangements, monitoring and evaluation

Résumé

La recherche et le développement (R & D) agricole sont essentiels pour accroître la productivité des petits agriculteurs et générer la croissance agricole en Afrique subsaharienne (ASS), mais les gouvernements continuent à sous-investir dans l'agriculture, et plus particulièrement dans la recherche et le développement (R & D)agricole. Après une décennie de stagnation durant les années 1990, les investissements et la capacité des ressources humaines dans la R & D agricole publique en Afrique subsaharienne ont augmenté de plus de 20 pour cent au cours de 2001-08. La plupart de cette croissance a cependant eu lieu dans une poignée de pays et était en grande partie le résultat des engagements accrus du gouvernement pour améliorer les salaires très bas et réhabiliter des infrastructures négligées, souvent après des années de sous-investissement. En outre, près de la moitié des pays d'Afrique subsaharienne pour lesquels des données chronologiques étaient disponibles durant cette période, ont connu une baisse de leurs niveaux de dépenses. De nombreux pays, en particulier ceux de l'Afrique centrale et de l'Ouest francophone, menacés par les systèmes de financement extrêmement fragiles, sont fortement tributaires du financement des donateurs, et font face à d'importantes fluctuations dans les niveaux de financement d'une année à l'autre.

Malgré des évolutions positives dans les niveaux de dotation de la R & D agricole de la plupart des pays, un grand nombre d'entre eux continuent à faire face à des problèmes importants de capacités. Dans certains pays, notamment en Afrique de l'Ouest francophone, les restrictions à long terme de recrutement dans le secteur public ont faussé l'âge moyen des scientifiquesà l'extrémité supérieure du spectre et ont laissé les agences aussi vulnérables comme leur personnel âgé approche la retraite sans unevoieclaire de succession. Les pays qui ont été en mesure de lever les interdictions de recrutement à long terme ont souvent dû faire face aux afflux des scientifiques diplômés d'université, jeunes et inexpérimentés, qui ont besoin d'une formation appropriée, mais manquant de mentors de niveau intermédiaire pour les guider. Attirer et retenir du personnel de recherche qualifié est un défi majeur. En outre, des possibilités de formation de troisième cycle au niveau national sont limitées dans de nombreux pays.

La structure organisationnelle de la recherche en Afrique subsaharienne est en place, mais elle est devenue très complexe, et beaucoup de liens potentiels et d'arrangements institutionnels restent sous-développés. S'appuyant sur les résultats et les délibérations lors de la conférence ASTI / IFPRI-FARA à Accra en Décembre 2011, un certain nombre d'orientations ont été identifiées qui sont nécessaires pour faire face aux nombreux défis des aspects de la R & D agricole en Afrique subsaharienne en matière des investissements durables par les gouvernements et les bailleurs de fonds, le développement du talent scientifique nécessaire, la création de liens entre les divers groupes des intervenants nationaux, et les interfaces de développement appropriées à travers les systèmes mondiaux et régionaux de recherche agricole.

Mots clés: R &D agricole; ressources financières, capacité des ressources humaines, arrangements institutionnels, suivi et évaluation

Background

Extensive empirical evidence demonstrates that agricultural research and development (R&D) investments have greatly contributed to economic growth, agricultural development, and poverty reduction in developing regions over the past five decades. Effectively disseminated new technologies and varieties resulting from R&D investments have enhanced the quantity and quality of agricultural produce, at the same time increasing sustainability, reducing consumer food prices,

providing rural producers with access to markets, and improving gender-based allocations and accumulations of physical and human capital within households. Given important challenges, such as rapid population growth, adaptation to climate change, increasing weather variability, water scarcity, and the volatility of prices in global markets, greater investment in agricultural R&D as an essential element in increasing agricultural productivity in the region.

Despite the well-documented evidence that the payoffs to agricultural research are considerable, many SSA countries continue to underinvest in agricultural R&D. Given the substantial time lag between investing in research and reaping its rewards—which is typically decades, not just years—agricultural R&D requires a long-term commitment in terms of sufficient levels of sustained funding and well-staffed research agencies.

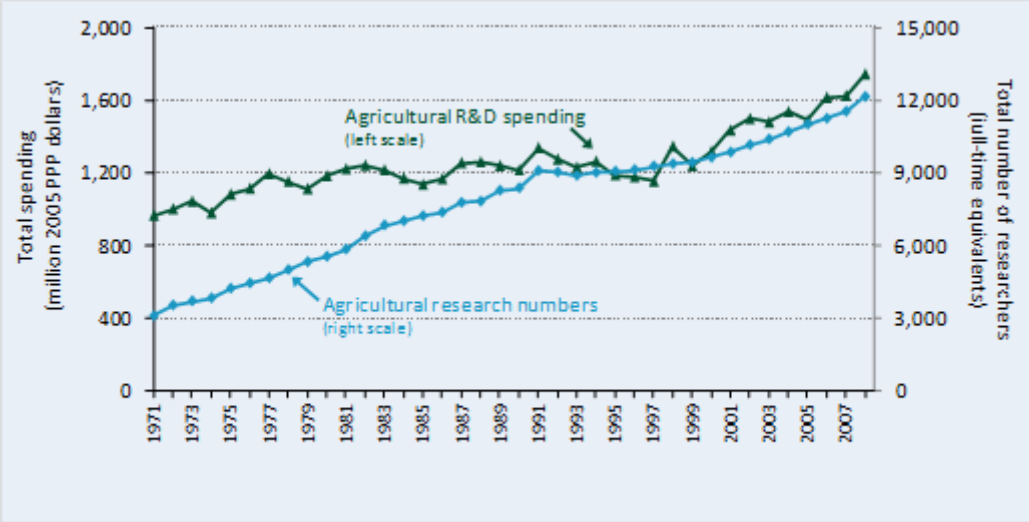
Quantitative data are essential for agricultural R&D stakeholders to be able to analyze trends in agricultural R&D investments and capacity, identify gaps, set future investment priorities, and better coordinate agricultural R&D across institutes, regions, and commodities. R&D indicators also play a key role in helping stakeholders monitor and benchmark the inputs, outputs, and performance of agricultural research systems at national and regional levels and to measure progress towards the successful implementation of science and technology (S&T)-related targets. They are also an indispensable tool when assessing the contribution of agricultural S&T to agricultural growth and to economic growth more generally. The Agricultural Science and Technology Indicators (ASTI) program of the International Food Policy Institute (IFPRI) is the international entity dedicated specifically to the collection, analysis and synthesis of information on agricultural R&D investment, capacity, and policy in developing countries[2].

Regional and National Agricultural R&D Spending and Human Resources Trends

After a decade of stagnation during the 1990s, investments and human resource capacity in public agricultural R&D averaged more than 20 percent growth in Sub-Saharan Africa (SSA) during 2001–08. In 2008, the region spent $1.7 billion on public agricultural R&D—in 2005 purchasing power parity or PPP dollars (a measure that adjusts for inflation and other cross-

[2] For more information, visit the ASTI website at www.asti.cgiar.org.

country cost differences)[3] and employed more than 12,000 full-time equivalent agricultural researchers (Fig. 1).



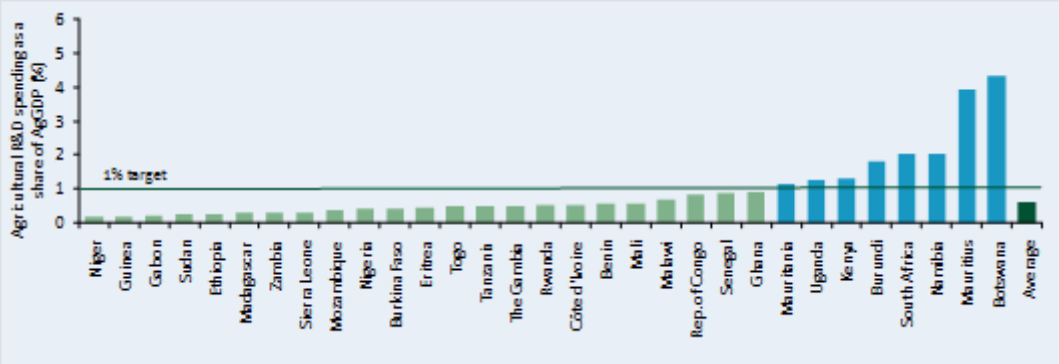
Source: Beintema and Stads (2011) based on ASTI datasets.

Figure 1. Trends in total public agricultural R&D spending and staffing, 1971–2008.

Regional average increases in spending and capacity during 2001–08 were largely driven by only a handful of countries. More than one-third of the growth in public agricultural R&D spending during this period is attributable to a $110 million increase in spending in Nigeria. Ghana, Sudan, Tanzania, and Uganda also experienced relatively high increases in total spending of between $25 and $56 million each. In contrast, Ethiopia and South Africa experienced notable declines ($28 and $12 million, respectively). Nigeria was also the main driver of the regional growth in staffing, accounting for 724 of the 2,285 increase in the region's number of FTE researchers during 2001–08. Ethiopia, Kenya, and Sudan reported significant R&D staffing increases as well. South Africa experienced the largest decline in public agricultural researcher numbers (140 FTEs), whereas changes in investment and capacity levels in the remaining ASTI countries were less severe in absolute terms during this period.

[3] Unless otherwise stated, all dollar values in this document provided are based on 2005 PPP exchange rates, which 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 public sector is defined, in this context, as government, higher education, and nonprofit agencies engaged in agricultural research. ASTI measures financial resources on a "performer" basis, meaning the entity undertaking

Absolute levels of public agricultural R&D spending and staffing varied considerably across ASTI's 32 sample countries. In 2008, Nigeria, South Africa, and Kenya invested $404, $272, and $171 million in agricultural R&D, respectively; in contrast 11 countries spent less than $10 million each. The 2008 distribution of research staff by country followed a similar pattern, with Ethiopia, Kenya, Nigeria, and Sudan each employing more than 1,000 full-time equivalent researchers, or FTEs (a measure that adjusts for staff time spent on nonresearch-related activities), and nine countries each employing fewer than 100 FTEs. Looking at the region's agricultural research intensity ratio (measured as total public agricultural R&D spending as a percentage of agricultural GDP), in 2008 SSA invested $0.61 per $100 of agricultural output on average (Fig. 2). This level falls below the national R&D investment target of at least 1 percent of GDP recommended by the New Partnership for Africa's Development (NEPAD)[4]. Only 8 of 31 ASTI countries (excluding Zimbabwe) for which data were available met this 1-percent target.

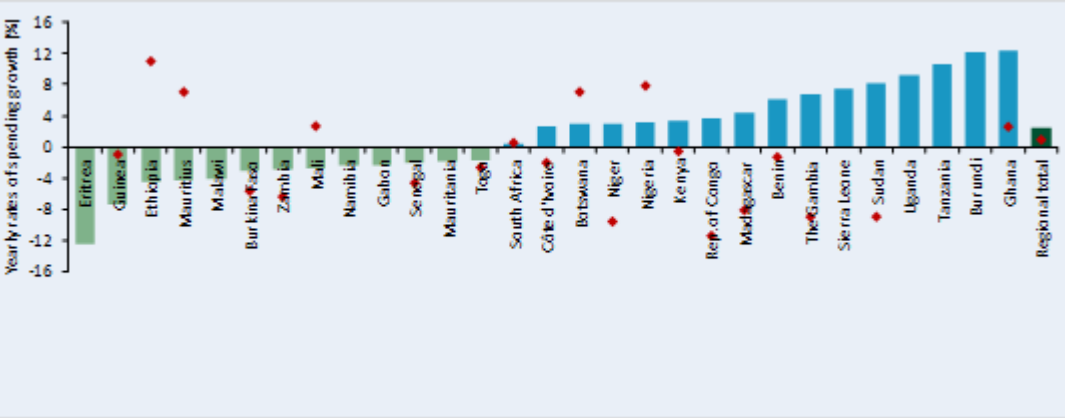


Source: Beintema and Stads (2011) based on ASTI datasets.

Figure 2. Agricultural research intensity ratios, 2008.

During 2001–08, 13 of 29 countries (excluding Rwanda, Mozambique, and Zimbabwe) recorded negative yearly growth in public agricultural R&D spending ranging from –1.6 to –12.4 percent per year, which is sizeable given that total spending for the region increased throughout this period (Fig. 3). Of these 13 countries, 7 are francophone countries located in West and Central Africa. In contrast, agricultural R&D investments in a number of countries increased substantially after 2000. Eight countries, including Ghana, Tanzania, Uganda, and Sudan,

[4]The Ministers attending the first NEPAD Ministerial Conference on S&T in 2003 vowed to increase national R&D spending to 1% of GDP – at least – by 2008.



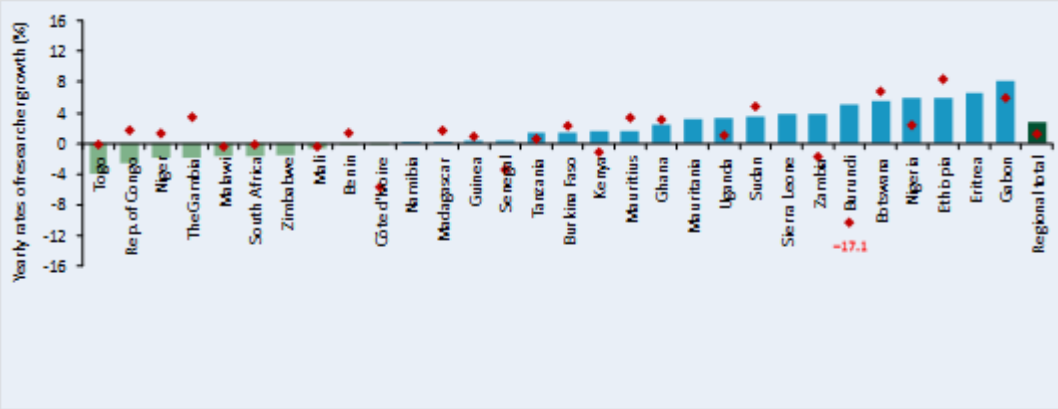
Source: Beintema and Stads (2011) based on ASTI datasets.
Notes: Bars reflect annual growth rates for 2001–08; red dots rates for 1991–2001. Compound yearly growth rates are calculated using the least-squares regression method.

Figure 3. Annual growth rates of public agricultural R&D spending, 2001-08 compared with 1991-2001.

recorded yearly growth rates of more than 6 percent. Spending in Nigeria grew at a comparatively moderate average rate of 3.2 percent per year. For some countries, growth reflected the re-establishment of agricultural R&D systems after periods of political unrest, whereas in others—such as Nigeria, Sudan, Tanzania, and Uganda—growth stemmed from increased national government commitment to agriculture in general and to agricultural R&D in particular.

Growth in agricultural research staffing varied less across countries compared with total spending (Fig. 4). In line with reduced spending levels, a number of francophone countries in West and Central Africa also reported declining capacity during 2001–08. Nevertheless, research staffing increased or remained fairly constant in most countries during 2001–08. Of the agricultural researchers employed in the ASTI countries in 2008, 30 percent were qualified to the PhD level, 43 percent to the MSc level, and 27 percent to the BSc level. Researcher qualifications varied considerably across countries. In just 14 of the 32 ASTI countries, more than 80 percent of the FTE researchers were trained to the postgraduate (PhD or MSc) level.

Despite growth in agricultural R&D capacity across the region, average levels of staff qualifications actually deteriorated somewhat in a combined sample of 30 ASTI countries



Source: Beintema and Stads (2011) based on ASTI datasets.
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Figure 4. Annual growth rates of public agricultural researchers, 2001–08 compared with 1991–2001.

(excluding Rwanda and Mozambique). The share of PhD-qualified staff was larger in the higher education sector than in the government or nonprofit sectors—52 percent in 2008 compared with 24 and 29 percent, respectively—but this is a common finding globally. The deterioration in average qualification levels was more pronounced at government agencies, where the share of BSc-qualified researchers increased from 27 to 31 percent during 2001–08 compared with 11 to 13 percent at the higher education agencies. It should be noted that an increasing number of support staff (technicians, research assistants, and laboratory assistants) have BSc, MSc, and occasionally PhD qualifications, but they are not classified as researchers.

Funding for African agricultural R&D is derived through a variety of sources, including national governments; donors, development banks, and (sub) regional organizations; producer organizations; the private sector; and internally generated revenues. Evidence indicates that growth in spending in Ghana, Nigeria, Sudan, Tanzania, and Uganda—the main drivers of regional growth—was largely the result of significant injections of government funding. The government funds the bulk of agricultural R&D activities in some countries, whereas others are extremely dependent on external funding. A number of R&D agencies generate significant revenues by selling goods and services, whereas for others the proceeds of sales are channeled to the national treasury.

Current Challenges

Many countries currently face significant financial and human resource challenges that urgently need to be addressed:

- **Low and declining levels of investment.** Some of the region's smallest countries have very low and declining levels of investment and human resource capacity, calling into question the effectiveness of their national agricultural R&D.

- **High levels of funding volatility.** Many African countries continue to be extremely dependent on unstable inflows of donor funding and development bank loans. Donor funding is typically short-term and ad hoc, leaving research programs vulnerable. Although many national governments have increased their commitments to agricultural research, allocations and disbursements continue to fluctuate, making it difficult for research agencies to attract and keep staff, develop and maintain facilities, and ultimately sustain viable research programs.

- **Lack of funding diversity.** Agricultural research is dominantly funded by national governments, donors, and development banks. Diversification of funding resources — for example, through the sale of goods and services and through private-sector participation and funding—remains limited.

- **Aging pools of researchers.** Lack of funding, civil unrest, and long-term hiring freezes have left many countries with an aging pool of researchers, many of whom will reach retirement age within the next decade. More recent recruitment initiatives have often resulted in a disproportionate intake of junior (BSc-qualified) researchers who require significant further training and mentoring, not only focusing on research, but also on management expertise.

- **Lack of human resource capacity.** Despite the overall growth in the total number of agricultural researchers, average qualifications levels have deteriorated in a number of countries in large part due to the recent influx of junior researchers, as mentioned above. Salaries and conditions of service at the main agricultural research agencies are often poor, and many agencies have lost a large number of researchers to the private sector and, in some instances, to universities that have the ability to offer more attractive positions, remuneration packages, and conditions. A (small)

number of agencies, however, are instituting staff retention strategies including, for example, regular staff performance evaluations, incentives such as better medical benefits, and the requirement that staff who receive training commit to ongoing employment for a set period of time.

Future Directions for Agricultural R&D: Reflections of the ASTI/IFPRI–FARA conference

The promises and challenges surrounding agricultural development, and specifically agricultural R&D, prompted the conference *Agricultural R&D: Investing in Africa's Future:—Analyzing Trends, Challenges, and Opportunities*, which was convened by ASTI/IFPRI and the Forum for Agricultural Research in Africa (FARA). The goal of the conference was to define a road map for revitalizing agricultural research in the region focusing on four principal themes: (1) sustainable financing of agricultural research, (2) options for training the next generation of agricultural scientists, (3) processes for effectively evaluating the performance of research institutes and systems, and (4) the efficient organization of national agricultural research activities supported by regional and international capacities. Based on a array of conference outputs comprising commissioned papers, case studies, panel discussions, and general deliberations, a number of important areas of moving forward were discussed for each theme and which were seen as key to revitalize agricultural R&D in the region.[5]

Sustainable finance

- National governments should re-assess their funding for agricultural research to address the persistent underinvestment problem. Increased long-term and consistent levels of funding that cover salaries, operating costs, and capital investments are needed to make national agricultural R&D more productive.
- The current situation of donor agencies funding the variable costs of research programs has become unsustainable. A new framework has to be developed whereby governments put forward strategic priorities and donors contribute budgetary support to those programs. This could potentially be worked out through the Comprehensive Africa Agriculture Development Program (CAADP) process.

[5] All conference outputs are available on www.asti.cgiar.org/2011conf, which also includes the conference synthesis on which this section is based.

- Regional collaboration in areas of mutual need is required to link countries with disproportionately low capacity with larger neighboring countries that have viable capacity.
- Reforms will have to be developed to facilitate private-sector participation. Regulatory reforms are also required to be implemented to encourage the spill-in of international technology.

Human resource development

- Countries with serious capacity gaps will need to address the high turnover of agricultural scientists through a series of measures, such as increasing the civil servant retirement age, improving remuneration packages, enhancing working conditions, and promoting agricultural science to young people as a beneficial and fulfilling career path.
- New innovative means of training will have to be developed to maintain quality, improve relevance to African and smallholder agriculture, build the capacity to develop human resources, develop so-called soft skills, and improve entrepreneurial ability.
- Capacity development focusing on individual professionals must be supported by institutional-level capacity strengthening in alignment with program implementation, national priorities, and regional development initiatives like CAADP. Further analysis is needed to determine the best approaches for systematic organizational change and institution building among the national research institutes.
- Financial support by governments and donor organizations needs to increase will all of the above transpire.

Measuring and improving effectiveness

- Monitoring and evaluation (M&E) activities within national agricultural research agencies have to institutionalized. This is a considerable challenge given capacity constraints both in terms of methods and data management, as well as determining appropriate incentives to drive accountability measures.
- Improved M&E capacity within NARIs can be highly complementary with modeling approaches that assess the contribution of agricultural research to overall agricultural growth, and can provide input into agricultural and science policy and public investment. These more systemic

approaches can provide an evaluation framework for agricultural innovation systems

Aligning and rationalizing institutional structures

- More in-depth analysis is needed to fill these knowledge gaps in evidence-based data and analysis that assess institutional-level developments in agricultural R&D in SSA at the national, regional, and international levels.
- An African funding base is needed to promote the sustainability of supranational agricultural R&D and overcome the problem of donor dependency.
- The CGIAR's regional research capacity is not accessible at the NARI or subregional level and has the potential to provide economies of scale and scope that are not currently available through the SROs. The organizational change taking place at both subregional and international levels provides an opportunity to define clearer institutional arrangements.

Concluding Remarks

Following a period of stagnation in the 1990s, total public agricultural R&D spending and capacity levels in SSA have increased. Most of the investment growth, however, occurred in a handful of countries; in many other countries, investment levels have stagnated or fallen. Some countries currently have such low investment and capacity levels that the impact of agricultural R&D on rural development and poverty reduction is questionable at best.

Well-developed national agricultural research systems and adequate levels of investment are important prerequisites for agricultural development, food security, and poverty reduction. The organizational architecture for SSA research is in place, but it has become highly complex, and many of the potential linkages and institutional arrangements remain underdeveloped. In recent years, governments have exhibited renewed interest in supporting agricultural development in SSA, returning agriculture and agricultural R&D to the political agenda. But this political support must be translated into a set of specific directives by governments, donors, and other R&D stakeholders as proposed at the ASTI/IFPRI–FARA conference. These are needed to address the many challenges agricultural R&D faces in SSA in terms on sustainable investments by governments and donors, development of the necessary scientific talent, creation of linkages between a diverse group of national stakeholders, and the development appropriate interfaces across global and regional agricultural research systems.