

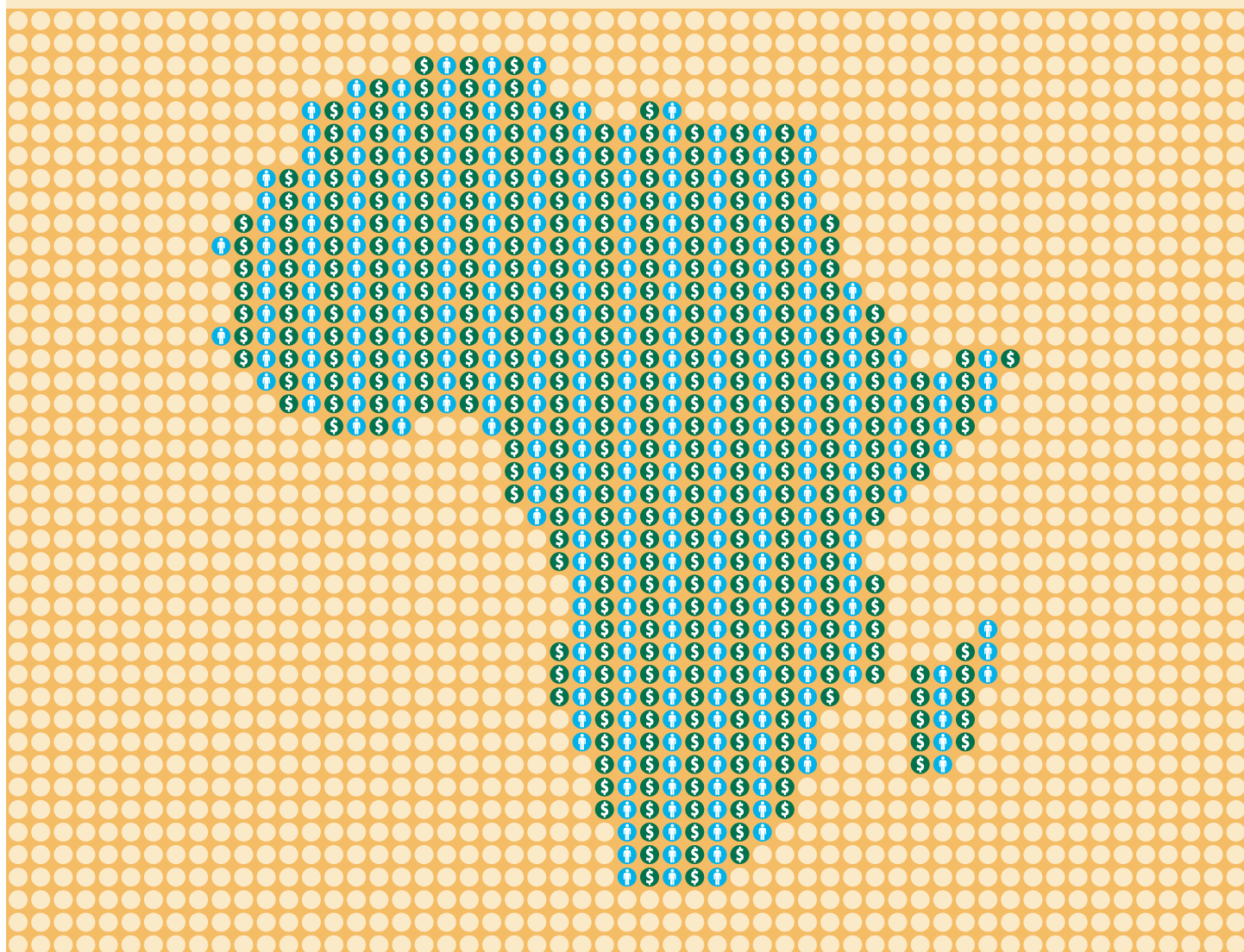
AGRICULTURAL R&D: INVESTING IN AFRICA'S FUTURE

Analyzing Trends, Challenges, and Opportunities

REFLECTIONS ON THE CONFERENCE

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The promise and challenges inherent in agricultural development in Sub-Saharan Africa prompted the conference, “Agricultural R&D: Investing in Africa’s Future—Analyzing Trends, Challenges, and Opportunities,” which was convened by the Agricultural Science and Technology Indicators (ASTI) initiative—facilitated by the International Food Policy Research Institute (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:

- ▶ sustainable financing of agricultural research;
- ▶ training the next generation of agricultural scientists;
- ▶ effectively evaluating the performance of research institutes and systems; and
- ▶ efficient organization of national agricultural research activities supported by regional and international capacities.

This document synthesizes the paper presentations, panel discussions and deliberations by the conference participants. The commissioned conference papers have been published as an ASTI/IFPRI–FARA Working Paper series (see insert), and a book synthesizing both the conference outcomes and further analysis will be prepared for publication in 2013. More information is available on the conference website at <http://www.asti.cgiar.org/2011conf>.

After three decades of low investment in agricultural research in Sub-Saharan Africa (SSA), African governments now have a range of new opportunities for such investment. The structural adjustment and market liberalization of the 1990s have generated increased private investment in agriculture, and agricultural growth is returning to 1970s’ levels in several of the region’s countries. Rising global food prices have made both donors and national governments treat agriculture as a priority again and, together with the rising prices of metals and other commodities, have sparked increased foreign investment in the region. This note provides a summary of the current state of agricultural research and development (R&D) in SSA and identifies important opportunities to address the many challenges R&D faces in SSA in terms of investments, human resources, organization, and achieving impact.



SUSTAINABLE FINANCING

Current Situation

Investments in public agricultural R&D in SSA increased by 20 percent between 2001 and 2008, following two decades of almost stagnant growth (although the total investment level remained low). This recent growth, however, occurred in only a handful of—often relatively large—countries; was directed mainly toward restoring some degree of parity and competitiveness in salary levels of research staff and rehabilitating neglected infrastructure and equipment; and appears to be unsustainable in the longer term. Investment levels in many other countries in the region, particularly in francophone West and Central Africa, have stagnated or fallen.

Agricultural R&D in SSA is primarily funded by national governments and donors, with variations across countries. Some countries continue to be highly donor dependent while others are funded almost completely through government allocations. Donor funding, together with large World Bank loans, generally supports operating costs and capital investment, but has been highly erratic. In recent years, both traditional and new donors—notably the Bill and Melinda Gates Foundation and large emerging economies such as Brazil and China—have shown renewed interest in funding agricultural research in Africa.

Major Challenges

Although a number of countries have increased their support to agricultural R&D, overall investment levels in most SSA countries remain below the levels required to sustain viable agricultural R&D programs that address current and future priorities. Mobilizing domestic political support for agriculture, and especially for agricultural R&D, has been difficult. One reason for this is the inherently long time lag between investing in research and attaining tangible benefits. Another reason is that evidence of high payoffs to agricultural R&D in SSA is limited. Most empirical studies showing high rates of return have been: i) based on specific projects or programs; ii) case studies incorporating technologies developed by the Consultative Group on International Agricultural Research (CGIAR); or iii) cross-country growth studies that include North Africa. At the same time donor funding, which as mentioned has been highly volatile, appears to have shifted to regional initiatives rather than national agricultural R&D programs.

Agricultural research in SSA is highly fragmented given the region's large number of countries and its complex agroecological zones and farming systems. Even small countries need a minimal level of financial capacity to access technologies and other outputs generated by national, regional, and global research providers. Such countries have usually more vulnerable research systems because low innovative capacity and uncertain funding limit their ability to take advantage of economies of scale and scope, causing reliance on technology spill-ins.

The private sector still plays a limited role in agricultural R&D in SSA. Private investment tends to be regionally limited—much of it occurs in South Africa—and focuses on a highly limited range of commodities, primarily hybrid maize.

Ways of Moving Forward

- ▶ **Mobilize greater government support for agricultural R&D.** National governments should reassess their inadequate funding of agricultural research. Increased and consistent levels of funding that cover salaries, operating costs, and capital investments over the long term are needed to make national agricultural R&D more productive. The Comprehensive Africa Agriculture Development Program (CAADP) process

offers governments a mechanism for structuring their investments. Better evidence of the value of and returns to agricultural R&D investments are needed to spur stronger domestic political support.

- ▶ **Coordinate donor support with national priorities.** The current situation of donors funding the variable costs of research programs has become unsustainable. It devolves much of the critical decisionmaking about research priorities to donors and skews the research agenda toward short-term goals that are not aligned with national and regional priorities. A new framework is needed whereby governments put forward strategic priorities and donors contribute budgetary support to those programs; this could potentially be worked out through the CAADP process.
- ▶ **Promote regional cooperation.** Funding trends have created a significant gap in agricultural research capacity between a few large countries and the remaining, generally smaller, ones. South Africa and Kenya, for example, are able to support research systems commensurate with the size of their overall economies, and a number of other large countries have succeeded in matching stable donor contributions with allocations from their national budgets. For countries with disproportionately low capacity, however, regional approaches make a lot of sense, at least in areas of mutual need and viable capacity in larger, neighboring countries.
- ▶ **Reform policy to facilitate private-sector participation.** The least developed source of sustainable financing for agricultural R&D in SSA is the private sector. Cultivating such private-sector funding involves developing a more explicit market demand for the products of agricultural research, which are also often associated with enhanced intellectual property rights. Collective action by farmers and related agribusinesses (often through formal associations), for example, has the potential to generate substantial additional resources for agricultural research in the region. These added resources are usually generated through some type of tax on specific commodities, either on exports or on supplies moving through a centralized marketing or processing supply chain. An added benefit of this approach is that decisionmaking on the use of the resulting funds would generally rest with producers and other stakeholders in the relevant value chain. Regulatory reforms also need to be implemented to encourage the spill-in of international technology.



HUMAN RESOURCE DEVELOPMENT

Current Situation

Talented, well-trained scientific staff is essential to produce high-quality agricultural research. The region's overall human resource capacity in agricultural R&D has increased notably in recent years. Comparatively more researchers hold PhD and MSc degrees, although the share of those qualified at the BSc level has also increased in some countries in recent years. In addition, female participation has improved in many countries. Nevertheless, many of the region's smallest countries still have very low, and in a few cases declining, levels of human resource capacity.

The region's universities, and particularly its faculties of agriculture, have been going through a quiet revolution that has improved the quality of education.¹ Growth in the number of private African universities, some offering programs related to agriculture, has created new opportunities for study. Changes in governance have facilitated greater autonomy for universities and allowed tuition fees to be adjusted to secure the necessary operational income. Students have pressured faculties to improve the quality of the training provided. Finally, the combination of growing links with the private sector and changing labor markets has prompted universities to become more responsive and innovative.

Major Challenges

Agricultural R&D staffing in SSA is at a critical juncture given a history of long-term civil service hiring freezes in many countries, which have resulted in an aging pool of research staff in national agricultural research institutes (NARIs), often combined with disproportionately young and inexperienced teams of recent recruits. In addition, salary levels, conditions of service, and facilities and equipment continue to be poor in NARIs, prompting researchers to pursue more attractive opportunities in higher education, the private sector, or abroad. The potential to fill the resulting staffing gap through graduate training in the North, as was done in the 1980s, is limited, partly because of the cost and partly because curricula are often not relevant to the unique needs of smallholder agriculture in SSA. The region's universities are also facing a number of constraints; in par-

ticular, increased workloads due to growth in the number of universities and in student intakes are putting pressure on staff and in turn affecting the quality of teaching and student supervision.

Ways of Moving Forward

- ▶ **Halt the prevailing high turnover of agricultural scientists.** Countries with serious capacity gaps will need to address these 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. Furthermore, the quality of scientists will need to be raised, requiring increased training opportunities.
- ▶ **Develop innovative training methods.** With the expansion of universities and the capacity built through graduate programs, significant scope still exists to further expand the higher education sector. The emerging "chokepoint", however, is MSc- and PhD-level training, given all the demands made upon it. Such training must maintain its quality, improve its relevance to African smallholder agriculture, build the capacity to develop human resources (that is, training the trainers), promote so-called soft skills (for example, computer-related skills), and foster entrepreneurial ability. This is a significant and complex task, currently being addressed by a number of innovative networks created in recent years, such as the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM).² Initiatives to improve post-graduate education can be supported by global advances in distance learning, electronic access to literature and knowledge sources, and Northern universities that are globalizing their programs through joint ventures with developing-country universities.
- ▶ **Strengthen institutional capacity to create an enabling environment.** Research institutions are frequently confronted with the need to demonstrate quick impact with limited resources, which can skew the research agenda toward short-term objectives. As a result, agricultural research capacity in SSA is generally developed through piecemeal (sometimes short-lived) approaches. Successful approaches will need to be scaled up to create an enabling environment for the sustainable implementation of development programs.

For this to occur, capacity development focused on individual professionals must be supported by strengthening institution-level capacity while pursuing program implementation, national priorities, and regional development initiatives such as CAADP. Further analysis is needed to determine the best approaches to systematic organizational change and institution building among the national research institutes. The Strengthening Capacity for Agricultural Development in Africa (SCARDA) program is a promising example.

- **Increase financial support.** All of the above can only happen with continuing and increased financial support by governments and donor organizations. To this end, the CAADP process is attempting to develop investment plans for agricultural tertiary education as part of integrated strategies for human resource development in agricultural research and rural development.



MEASURING AND IMPROVING EFFECTIVENESS

Current Situation and Major Challenges

In the past decade or so, donors and other stakeholders have understandably called for increased accountability in the conduct of agricultural research. One approach has focused on the institutional separation of decisions about the allocation of financial resources from decisions on the content and implementation of research so that funding agencies have more input into priorities and in making future funding contingent on achieving certain results. As previously mentioned, much of the critical decisionmaking about research priorities has been devolved to the donors and as a side effect has skewed the research agenda toward short-term goals that are often out of alignment with national and regional priorities. Yet, where research systems remain constrained by human capital, infrastructure, and operational funds for field work, it is difficult to demonstrate improvements in the efficiency of resource allocation and in accountability for the funds invested. This issue is exacerbated by the methodological difficulty of evaluating agricultural research, which by itself is a major contributor to the underinvestment problem. Long time lags from

the point of investment to the manifestation of returns are inherent in the research process, as is uncertainty of its success—especially in speculative research activities. Most important, for research outputs to be adopted and have an impact on development outcomes, other, well-functioning support services and institutions must be in place. Given the past challenges of demonstrating a causal relationship between research and development outcomes, research evaluations have primarily taken the form of ex post impact assessments (i.e., following the completion of a research project/program). Such assessments primarily focused on successful technologies. These, however, do not provide evidence of returns to the total investment in agricultural research; in addition, they only partially inform future investment decisions and provide limited evidence on the effectiveness of changes in organizational structures or management.

The application of evaluation methods has expanded significantly in the past decade, particularly at the project level and in response to donor requirements. More recently, however, institutional reform has prompted the development of new monitoring and evaluation (M&E) methods. Results-based performance monitoring is a central feature of ongoing institutional reform within the CGIAR and programmatic changes within SSA's subregional organizations (SROs); it is also now being incorporated into CAADP's investment plans. Too often, evaluation is interpreted in the context of research accountability—a necessary objective in its own right, but not to the exclusion of managing organizational change and improving organizational performance. In efforts to redress this issue, three different yet complementary efforts are in progress to develop more robust M&E methods for agricultural research in SSA: (i) expanding the focus of M&E from the project level to the institutional level (including some exploration of the innovation system level); (ii) shifting the focus from accountability to donors to accountability to governments and, just as important, to farmers through participatory M&E; and (iii) balancing accountability-based assessment with M&E focused on the operational management of research institutions.³ Metrics for M&E are relatively well defined on the input side such as levels of investment or number of researchers. They are, however, more challenging from an output perspective, especially when the goal is identifying the link between research outputs and outcomes.

Fully developed M&E systems for agricultural research are costly because it is expensive to establish baseline measures (for example, farmer surveys); the diverse types of research conducted necessitate different performance

metrics; and data requirements are complex and diverse. Moreover, M&E must compete with the actual research for a share of limited time and financial resources. For these reasons, little attention has been paid to organizing efficient M&E systems to fulfill both the accountability and management functions.⁴

Ways of Moving Forward

- ▶ **Institutionalize M&E within NARIs.** This is a considerable challenge given capacity constraints both conducting research and managing research data, as well as in determining appropriate incentives to drive accountability measures.⁵ The primary internal demand is likely to be for information to support improvements in operational management. Given these obstacles, M&E systems are only as good as the intent of management to promote organizational change. Improved funding flows should be tied to improved M&E systems in NARIs. Improved operations and management should receive particular emphasis.
- ▶ **Use existing modeling approaches.** Improved M&E capacity within NARIs can complement modeling approaches that assess the contribution of agricultural research to overall agricultural growth. Enhanced M&E can provide guidance for agricultural and science policy and public investment. M&E methods include economic models that rigorously link R&D to productivity growth and other outcomes and can be used to simulate various R&D spending strategies.⁶ These more systemic approaches can also provide an evaluation framework for agricultural innovation systems.⁷



ALIGNING AND RATIONALIZING INSTITUTIONAL STRUCTURES

Current Situation

The financial, human resource, and management constraints on agricultural research at the national levels (see previous sections) have often prompted organizational

reform strategies. What could be called the “architectural structures” that underpin agricultural research in SSA have significantly evolved over the past four decades. In the post-independence period of the 1970s and 1980s, agricultural research departments in ministries of agriculture were consolidated or transformed into semiautonomous NARIs in many countries, with direct donor support. During this time, five CGIAR centers were established in SSA, while most other CGIAR centers established regional offices and research networks in SSA.⁸ During this period, the CGIAR was particularly focused on training scientists in various nations. During the downturn in donor funding in the 1990s, the focus shifted to developing the SROs, building on the experience of one such organization, the Southern African Centre for Co-operation in Agriculture and Natural Resources Research and Training (SACCAR). This culminated in the formation of the Forum for Agricultural Research in Africa (FARA) in 2002. During their collaboration, the SROs and CGIAR initially focused on coordinating an expanding number of research networks. These networks were primarily initiated by the CGIAR centers but managed independently by each center.⁹ By the late 2000s, both the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and the West and Central African Council for Agricultural Research and Development (CORAF/WE CARD) abandoned their network coordination roles and donor funding shifted from support to CGIAR research networks to program structures of SROs, which are organized around seven themes and run primarily as competitive grant programs.

At about the same time, the World Bank began to develop and fund the East Africa Agricultural Productivity Program (EAAPP) and the West Africa Agricultural Productivity Program (WAAPP).¹⁰ As part of these programs, certain NARIs are receiving support to become “regional centers of excellence” in particular commodities which can result in spill-ins into neighboring countries in the region. Two models for the organization of supranational research were thus in operation in SSA as of 2011.

The result is a hierarchical structure of national systems, SROs, and international centers, much of which remains dependent on international public funding (the SROs, FARA, EAAPP, WAAPP, and CGIAR are completely dependent on such funding). The critical questions going forward are (1) how productive are the capacities at each level of the hierarchy, and (2) are the institutional arrangements linking the various levels sufficient to support the needed increases in agricultural productivity?

Major Challenges

NARIs are still the primary instrument of agricultural research in most countries and receive the vast majority of investment (an average of around 80 percent in 2008). They remain the vehicles through which the regional programs are implemented and with which the CGIAR centers collaborate to undertake some of the applied research and virtually all of the adaptive research, as well as the release and testing of new technologies, such as improved varieties. For this structure to work, a critical level of capacity is needed within the NARIs. As indicated earlier, significant scope exists to further expand the higher education sector, but this will require more sustainable levels of research funding.

While some countries have decentralized management and decisionmaking within NARIs, for the foreseeable future the NARI model will continue to be the focus of longer term applied and adaptive research. The relative balance between applied and adaptive research will depend on what appears to be a permanent differentiation in SSA between large- and small-country systems and on the ability of smaller countries to effectively access relevant technologies and research capacities through regional and international programs. These critical capacities will depend on government investments, as only the World Bank remains a consistent funder of NARIs and then only on a selective basis. Additional funding at the national level is essential for countries to participate effectively in regional and international agricultural research systems.

Agricultural innovation systems (AISs) offer an evolving framework for organizing agricultural research at the national level. AISs focus on system-level architectural structures in order to promote innovation, produce practically applicable research, and, most important, create the institutional linkages necessary to support innovation. In SSA, however, innovative processes occur against a backdrop of agrarian economies with underdeveloped markets, infrastructure, and private investment in agriculture. The goal is to develop more integrative AISs in which agricultural research is one contributor to innovation in the agricultural sector and many other actors provide inputs into R&D and innovation processes. The challenge for African NARIs is developing mechanisms that will support these increased interactions, and associated transaction costs, while at the same time enhancing research linkages at subregional and international levels. This work must be done with an understanding that, in many countries, extension is undergoing major restructuring,

private investment remains limited, and civil society involvement is growing rapidly with democratization.

The SROs and programs like EAAPP and WAAPP approach SSA's small-country problem by attempting to develop scale economies at the regional level. EAAPP and WAAPP try to create such economies through coordinated investments in specific NARIs' capacities and organizing programs that will promote regional spillovers. SRO regional programs, on the other hand, operate by establishing competitive grant systems. Large countries, which often have more advanced NARIs, have advantage in competing for these grants. Such programs, however, are relatively short term, support only minimal capital investment, and provide minimal opportunities for regional spill-ins of technology. Moreover, the SROs are still consolidating their relatively new program structure. The research supported by WAAPP and EAAPP is still occurring within a national context, because funding is provided through national loans to particular countries that, by nature, limit potential investment in regional research and have inherent sustainability problems due to their fixed, project-based timeframes. In addition, linkages to the commodity research of the CGIAR centers is limited because the pathways through which the centers traditionally engaged with and channeled research spill-ins to NARIs—that is, the networks that were coordinated by the SROs—have effectively been cut off. To a large extent it is not within the current plans of Africa's regional economic communities to rebuild these networks either.

Other key issues are how scale economies will be exploited under subregional competitive grant schemes, and how spill-ins to small countries can be promoted efficiently. It is also important to recognize that the SROs' primary role is one of coordination and that, because they are entirely donor driven, they are limited in how much capacity they can develop. Whether the SROs will be effective in rationalizing the allocation of regional resources to research, improving research coordination, and facilitating international knowledge spillovers remains to be seen. Also, will they be effective instruments for addressing the small-country problem and mobilizing national support for R&D? These questions will continue to underpin decisions on regional approaches to R&D.

Evidence shows that the CGIAR has contributed significantly to increased total factor productivity in SSA over the past three decades and that investments in the CGIAR's and NARIs' work in the region are complementary. But these results come from the period of significant

investment in CGIAR research networks, which were mostly funded by donors and linked to national and sub-regional programs. The shift in donor funding away from these networks to competitive grant programs in the SROs has resulted in a weakening of institutional linkages with a potential decline in the CGIAR's contribution to African agricultural growth. Furthermore, the CGIAR is currently undergoing major structural reforms. Most of its research will be executed through 15 global research programs, but how these will be deployed in SSA and to which extent capacity building will be an important component is unclear at this stage.

Ways of Moving Forward

- ▶ **Undertake further fact-finding and analysis.** Evidence-based analysis of institutional-level innovations in agricultural R&D in SSA—nationally, regionally, and internationally—is extremely limited. More in-depth analysis is needed to fill these knowledge gaps.
- ▶ **Develop an African funding base to support the supranational research agenda.** An African funding base with national government ownership is needed to promote the sustainability of supranational agricultural R&D and overcome the problem of donor dependency. Furthermore, strategic commissioning of research by SROs should shift away from competitive grants to mechanisms that more appropriately support supranational initiatives and demonstrate the value of regional approaches to national governments.
- ▶ **Improve institutional linkages through the new CGIAR system.** 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 SROs and the CGIAR provides an opportunity to define clearer institutional arrangements. The CGIAR reform also offers a great opportunity for the SROs to link with the CGIAR's global research programs, which are structured programmatically rather than by location, offering broader potential research linkages not only across the region, but also between SSA and other regions. Certain African countries may need to develop a strategy for linking with the CGIAR. Development of such a strategy is currently being coordinated through the CAADP process.



CONCLUDING REMARKS

Agricultural R&D is critical to increasing smallholder productivity and generating agricultural growth in SSA, but African governments persistently underinvest in agriculture, particularly in agricultural research. The organizational architecture for African R&D is in place, but it has become highly complex, and many of the potential linkages and institutional arrangements remain underdeveloped. Structuring agricultural research poses significant challenges given the need to address highly complex and changing agendas, develop the necessary scientific talent, forge links with a diverse array of domestic stakeholders, and develop appropriate technical interfaces across global and regional agricultural research systems—all under extremely limited budgets.

While the papers and discussions emanating from the conference noted important progress and developments, they also brought to light key issues still to be explored, important knowledge gaps yet to be filled, and specific recommendations for addressing current and imminent challenges. Further data and analysis are needed, specifically in the areas of measuring performance and aligning and rationalizing institutional structures. It is hoped that, in addition to informing the future directions of ASTI and FARA activities, insights into these areas will benefit the many and varied stakeholders in African agriculture and R&D, and promote a clearer focus for moving forward.

END NOTES

1. This has partly been driven by the significant expansion of private-sector universities, together with an increase in the number of students completing secondary education since the 1990s and early 2000s. While the courses offered tend to focus on growth areas, such as business, information technology, and communications, some expansion has also occurred in agriculture and related areas.
2. RUFORUM focuses on linking research and course work, ensuring the relevance and applicability of the curriculum, enhancing breadth and depth of development-related disciplines, and maintaining quality assurance across participating faculties of agriculture.

3. The process of monitoring performance in crop breeding programs illustrates the complexity involved in M&E. Investors want demonstrable evidence of success, but more effective monitoring requires that the performance of the breeding program itself be measured, together with its design and objectives. Metrics can include varieties produced, released, or adopted by farmers; seed production levels; or incremental or aggregate yield increases in crop production by adopting farmers. A full assessment of whether the breeding program produces a return on investment cannot occur until it is possible to assess the change in aggregate productivity, but significant time lags are associated with that measure, so a proxy needs to be determined. Determining metrics for continuously evaluating research productivity is still an evolving area, and one that needs to inform research planning and provide a satisfactory level of accountability to investors.
4. One activity that deserves more attention is conducting standardized farm surveys. These surveys can provide essential data characterizing the agricultural research process, while at the same time serving as baselines for monitoring research performance at the farm level. In Africa there has been an explosion of baseline farm surveys, many of which are not well designed or effectively used; most only meet the needs of specific projects. Working toward more systematic farm survey design and archiving would be an important step toward containing the costs of M&E of agricultural research in SSA.
5. For example, M&E systems developed for Ghana and Nigeria demonstrate critical weaknesses their interactions with both farmers and the private sector, and lack of capacity in tracking research outputs and their adoption.
6. The models also include computable general equilibrium models that capture multiplier effects and broader economic linkages (for example, among labor markets).
7. Capacity for undertaking these types of studies has shifted to economic policy research institutes, such as Tegemeo in Kenya or the Tanzania Development Research Institute—both of which were established as policy institutes during the structural adjustment period.
8. These were the International Institute for Tropical Agriculture (IITA); the West Africa Rice Development Association (WARDA), now known as AfricaRice; the International Livestock Center for Africa (ILCA), which was later merged with the International Laboratory for Research on Animal Diseases (ILRAD) to form the International Livestock Research Institute (ILRI); and the International Center for Research on Agro-Forestry (ICRAF), now known as the World Agroforestry Centre.
9. By the beginning of 2000, ASARECA acted as a platform for coordinating 17 networks in East and Central Africa.
10. A similar program for Southern Africa is in the planning phase.



WHY DO AFRICAN GOVERNMENTS UNDERINVEST IN AGRICULTURAL R&D?

WORKING PAPERS

- ▶ Hans P. Binswanger-Mkhize, Derek Byerlee, Alex McCalla, Michael Morris, and John Staatz. **The Growing Opportunities for African Agricultural Development.**
- ▶ Samuel Benin and Hans P. Binswanger-Mkhize. **Political Economy of Agricultural Incentives and Public Expenditures: With Special Reference to Africa.**
- ▶ Derek Byerlee. **Producer Funding of R&D in Africa: An Underutilized Opportunity to Boost Commercial Agriculture.**
- ▶ Keith O. Fuglie and Nicholas Rada. **Policies and Productivity Growth in African Agriculture.**
- ▶ Alejandro Nin-Pratt. **Agricultural R&D Investment, Poverty and Economic Growth in Sub-Saharan Africa: Prospects and Needs to 2050.**
- ▶ David J. Spielman, Fatima Zaidi, and Kathleen Flaherty. **Changing Donor Priorities and Strategies for Agricultural R&D in Developing Countries: Evidence from Africa.**
- ▶ Gert-Jan Stads. **Africa's Agricultural R&D Funding Rollercoaster: An Analysis of the Elements of Funding Volatility.**

CASE STUDIES

- ▶ Gbologade B. Ayoola and Aliyu Sabi Abdullahi. **Nationally Financed Agricultural Research: A Case Study on Nigeria.**
- ▶ Deogratias Lwezaura. **Government Funding for Agricultural R&D: A Case Study on the Tanzanian Division of Research and Development.**
- ▶ Jonathan Makau Nzuma. **Producer Funding of Agricultural Research. The Case of Kenya's Tea Industry.**

OTHER MATERIALS

- ▶ Ruben Echeverría. **Discussant report.**
- ▶ Summary panel discussion on **Perspectives from Donor Organizations.**

HUMAN RESOURCE DEVELOPMENT FOR AGRICULTURAL R&D

WORKING PAPERS

- ▶ Suresh Chandra Babu, Irene Annor Frempong, and Kwadwo Asenso-Okyere. **Enhancing Capacity for African Agricultural Research: Conceptual Framework, Models, and Lessons.**
- ▶ Nienke Beintema and Michael Rahija. **Human Resource Allocations in African Agricultural Research: What Do The Data Tell Us?**
- ▶ Joyce Lewinger Mook. **Network Innovations: Building the Next Generation of Agricultural Scientists in Africa.**



- ▶ Louis Sène, Frikkie Liebenberg, Mick Mwala, Festus Murithi, Séraphine Sawadogo, and Nienke Beintema. **Staff Aging and Turnover in Agricultural R&D: Lessons from Five National Agricultural Research Institutes in Africa.**

CASE STUDIES

- ▶ Aissetou Drame-Yaye, Sebastian Chakeredza, and August B. Temu. **Why Agricultural Faculties Have Not Been Able To Attract Good Students**
- ▶ Frikkie Liebenberg. **Staff Aging and Turnover in African Agricultural Research: A Case Study on the Agricultural Research Council and the Faculties of Natural and Agricultural Sciences and Veterinary Sciences.**
- ▶ Mick S. Mwala and Moses Mwala. **Staff Aging and Turnover Agricultural Research: A Case Study on Zambia Agricultural Research Institute.**
- ▶ Festus Murithi and Caroline Minayo. **Staff Aging and Turnover in Agricultural Research: A Case Study on Kenya Agricultural Research Institute.**
- ▶ Patrick Okori. **Capacity Building in Agricultural Research: A Case Study on Uganda's Makerere University.**
- ▶ Séraphine Kaboré Sawadogo, Issa Ouédraogo, and Traoré San. **Staff Aging and Turnover Agricultural Research: A Case Study on Burkina Faso Environment and Agricultural Research Institute**
- ▶ Louis Sène. **Staff Aging and Turnover Agricultural Research: A Case Study on Senegalese Agricultural Research Institute**

OTHER MATERIALS

- ▶ Summary panel discussion **How to Address Training Needs.**

MEASURING AND IMPROVING THE EFFECTIVENESS OF R&D SYSTEMS

WORKING PAPERS

- ▶ Arega Alene, Yigezu Yigezu, Jupiter Ndjeunga, Ricardo Labarta, Robert Andrade, Aliou Diagne, Rachel Muthoni, Franklin Simtowe, and Tom Walker. **Measuring the Effectiveness of Agricultural R&D in Sub-Saharan Africa from the Perspectives of Varietal Output and Adoption: Initial Results from the Diffusion of Improved Varieties in Africa Project.**
- ▶ Leonard Oruko and Howard Elliott. **The Role of Evaluation in Strengthening Agricultural R&D in Sub-Saharan Africa: Information, Instruments and Actors.**
- ▶ Catherine R. Ragasa, Aliyu Sabi Abdullahi, and George Owusu Essegbey. **Measuring R&D Performance within an Innovation System Perspective: An Illustration from the Nigeria and Ghana Agricultural Research Systems.**

OTHER MATERIALS

- ▶ Samuel Benin. **Discussant report.**

ASTI/IFPRI–FARA Conference Outputs



ALIGNING AND RATIONALIZING INSTITUTIONAL STRUCTURES OF AGRICULTURAL R&D

WORKING PAPERS

- ▶ Ponniah Anandajayasekeram. **The Role of Agricultural R&D within the Agricultural Innovation Systems Framework.**
- ▶ Kathleen Flaherty. **The Agricultural R&D Challenges of Small Countries in Sub-Saharan Africa.**
- ▶ Michael Johnson, Sam Benin, Xinshen Diao, and Liangzhi You. **Setting Priorities of Regional Agricultural R&D Investments in Africa: Incorporating R&D Spillovers and Economy-wide Effects.**
- ▶ Arno Maatman, Mariana Wongtschowski, Willem Heemskerk, Nour Sellamna, Kristin Davis, Silim Nahdy, Washington Ochola, and Dan Kisauzi. **Dynamic Networks of Interactive Learning and Agricultural Research for Development: Three Critical Roles for Agricultural Advisory Services.**
- ▶ Carl Pray, David Gisselquist, and Latha Nagarajan. **Private Investment in Agricultural Research and Technology Transfer in Africa.**
- ▶ Johannes Roseboom. **Supranational Collaboration in Agricultural Research in Sub-Saharan Africa.**

OTHER MATERIALS

Yusuf Abubakar. **Discussant report.**



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