



The critical human, financial, and institutional capacity issues affecting West African Agricultural Research & Development



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Executive Summary

Public agricultural R&D spending has grown significantly in West Africa since the turn of the millennium, rising from \$418 million in 2000 to \$648 million in 2011. On the average, this increase only represents just 0.39 percent of their combined agricultural gross domestic product (AgGDP), a ratio well below both the average for Sub Saharan Africa (SSA) as a whole (0.51 percent), and the minimum 1-percent target recommended by the NEPAD.

Member states of ECOWAS consists of a relatively large number of small countries, with a relatively small agricultural research systems. They are faced by numerous challenges which limits them in taking advantage of economies of scale and scope. They generally have much to gain from increased regionalization. Furthermore, they take advantage of the coordination of agricultural R&D through the West and Central African Council for Agricultural Research and Development (CORAF/WECARD).

The ECOWAS Regional Research Policy, developed in 2012, seeks greater involvement of the West African research community in the formulation of ECOWAS's programs. Relevant ministers of ECOWAS member countries indicated the need for information on the status of scientific research capacity. In view of this, CORAF/WECARD solicited the support of Agricultural Science and Technology Indicators (ASTI) program of IFPRI for an in-depth assessment of critical human, financial, and institutional capacity issues was needed on agricultural research in West Africa.

Between 2013–2014, ASTI, CORAF/WECARD and national focal points carried out the assessment of the National Agricultural Research Institutes (NARIs) in six ECOWAS member countries: (i) National Institute of Agricultural Research of Benin (INRAB); (ii) Environment and Agricultural Research Institute (INERA), Burkina Faso; (iii) Ten institutes involved in agricultural research under the Council for Scientific and Industrial Research (CSIR), Ghana; (iv) Senegalese Agricultural Research Institute (ISRA);(vi) Sierra Leone Agricultural Research Institute (SLARI); and (vii) Togolese Agricultural Research Institute (ITRA). The assessment included a quantitative survey to collect information on human and financial resources, R&D infrastructure, and R&D outputs. A series of interviews and staff motivation surveys were carried out with selected researchers and managerial staff.

This current synthesis highlights the cross-cutting trends and challenges that has emerged from the assessment. It is structured within five broad areas: funding capacity, human resource capacity, research outputs, research-related infrastructure, and institutional conditions.

- On the R&D Funding: (i) Growth in agricultural R&D spending over time, but not everywhere and not quickly enough; (ii) Widespread underinvestment; (iii) Governments not always acting on their stated intentions and commitments on the day-to-day operations of agricultural R&D institutes and their planned research activities based on anticipated funding levels; (iv) Ongoing high levels of donor dependency; (v) Donor dependency as a major cause of yearly funding volatility; (vi) WAAPP targets training and R&D infrastructure, not actual research; (vii) Disincentives to generate funding through the sale of goods and services, and (viii) Lack of national competitive agricultural R&D funds
- On the Human Resources: (i) Inadequate numbers of researchers, particularly in certain key disciplines; (ii) Aging pools of researchers, particularly at the PhD level; (iii) Female researchers severely underrepresented; (iv) Poor incentive structures for researchers resulting in high staff turnover; (v) Limited access to in-country postgraduate training
- On the R&D Outputs: (i) Low scientific output of research institutes; (ii) Limited innovative capacity of smaller national agricultural research systems
- On the R&D Infrastructure: (i) Outdated research infrastructure impedes the conduct of productive research; (ii) WAAPP-supported infrastructure upgrades only target priority commodities; (iii) Lack of staff training on the operation of R&D equipment impedes its use
- On the Institutional Structure of Agricultural R&D: (i) Lack of (semi)autonomous status or reporting to an entity other than Ministry of Agriculture; (ii) Lack of strategic planning within many national agricultural

research institutes; (iii) Weak linkages between research and extension impede the adoption of improved varieties.

Despite this increased support to agricultural R&D with WAAPP, West Africa is still severely lagging behind other parts of Africa when it comes to agricultural R&D capacity and investment. Well-developed national agricultural research systems and adequate levels of investment and human resource capacities are prerequisites in the attainment of agricultural development, food security, and poverty reduction. Success in achieving ambitious future agricultural transformation targets set by CAADP and the 2014 Malabo Declaration are intrinsically dependent on sufficient and stable financial resources for agricultural R&D and the development of adequate human and institutional capacities.

This report concludes with a set of national and regional policy recommendations for ECOWAS's Council of Ministers of Agriculture, national-level decision makers, and other stakeholders: (i) Governments must address underinvestment in agricultural R&D and take the necessary policy steps to diversify funding sources; (ii) Governments must invest in training and capacity building and remove status and salary discrepancies between NARI researchers and university-based researchers; (iii) Governments must develop long-term national agricultural research policy agendas; (iv) Governments must provide stronger institutional, financial, and infrastructural support to NARIs. Governments will also need to provide the necessary policy environment to stimulate cooperation among the country's agricultural R&D agencies in order to maximize synergies and efficiencies in the use of the scarce resources available to universities and government agencies.

1. Introduction

High population growth, deteriorating soils, climate change, and volatile food prices are major factors affecting food security in West Africa. To respond effectively to these challenges, agricultural productivity in West Africa needs to be accelerated without delay. Given widespread evidence that investments in agricultural research and development (R&D) have tremendously enhanced agricultural productivity around the world over the past five decades, West African governments have a critical responsibility when it comes to providing sufficient and sustained funding for agricultural R&D and creating a more enabling environment for agricultural innovation to flourish.

Public agricultural R&D spending has grown significantly in West Africa since the turn of the millennium, rising from \$418 million in 2000 to \$648 million in 2011 (in 2005 PPP prices; Table 1). The number of full-time equivalent (FTE) agricultural researchers has grown rapidly as well, with close to 5,000 FTE researchers engaged in agricultural R&D in 2011. Nevertheless, member states of the Economic Community of West African States (ECOWAS) spent just 0.39 percent of their combined agricultural gross domestic product (AgGDP) on agricultural R&D in 2011, a ratio that is still well below both the average for Sub Saharan Africa (SSA) as a whole (0.51 percent), and the minimum 1-percent target recommended by the New Partnership for Africa's Development (NEPAD) and the United Nations.

ECOWAS consists of a relatively large number of small countries, almost all of which also qualify as having relatively small agricultural research systems. Small countries face particular challenges when undertaking agricultural R&D because they lack the ability to take advantage of economies of scale and scope. These countries generally have much to gain from increased regionalization. Regional economic communities in Africa have strengthened gradually over the past decade, as has the regional and sub-regional coordination of agricultural R&D through initiatives like the West and Central African Council for Agricultural Research and Development (CORAF/WECARD).

ECOWAS's Regional Research Policy, developed in 2012, seeks greater involvement of the West African research community in the formulation of ECOWAS's programs. Relevant ministers of ECOWAS member countries have validated the Regional Research Policy, which is a broad framework for harmonizing and establishing synergy among scientific research initiatives in various sectors, including the agricultural sector. The ministers indicated that information on the status of scientific research capacity would need to be improved, and determined that an in-depth assessment of critical human, financial, and institutional capacity issues was needed on agricultural research in West

and Central Africa. To accomplish this assessment, CORAF/WECARD solicited support from the Agricultural Science and Technology Indicators (ASTI) program of the International Food Policy Research Institute (IFPRI).

Table 1. Public agricultural research spending and researchers, 2000–2011

Country	Spending (million 2005 PPP dollars)			Researchers (full-time equivalents)		
	2000	2008	2011	2000	2008	2011
Benin	12.9	23.1	26.2	121.3	121.6	155.7
Burkina Faso	23.1	19.8	25.4	209.4	246.4	218.0
Cape Verde	na	1.8 ^a	2.1	na	23.0 ^a	21.0
Côte d'Ivoire	51.1	37.2	37.8	143.0	122.6	130.6
The Gambia	4.2	4.4	5.5	52.4	50.2	65.9
Ghana	42.5	57.2	68.1	469.6	499.0	607.0
Guinea-Bissau	na	0.3 ^a	0.2	na	11.0 ^a	9.0
Liberia	na	4.0 ^a	4.8	na	18.9 ^a	45.1
Mali	33.5	25.3	33.6	232.8	318.7	307.0
Niger	4.7	6.3	na	110.2	93.4	na
Nigeria	190.3	402.3	393.9	1,310.9	2,051.0	2,687.6
Senegal	23.8	23.8	24.8	133.3	134.3	112.2
Sierra Leone	na	6.6	6.9	na	58.6	81.7
Togo	13.6	8.3	7.6	94.8	67.1	114.7
Total	399.7	620.4	636.9	2,877.7	3,815.8	4,555.5

Source: Compiled by authors from ASTI country factsheets.

Notes: "na" denotes that data were unavailable. Total includes estimated data for countries without complete time series. To facilitate cross-country comparisons, financial data have been converted to 2005 purchasing power parity (PPP) prices using the World Bank's World Development Indicators. PPPs measure the relative purchasing power of currencies across countries by eliminating national differences in pricing levels for a wide range of goods and services. Full-time equivalents (FTEs) only take into account the time researchers actually spend on research, as opposed to other activities like teaching, time spent on secondment to other agencies, or unrelated administrative duties.
a. 2009 data.

Between the periods of 2013–2014, ASTI, CORAF/WECARD, and national focal points carried out the assessment of the national agricultural research institutes (NARIs) in six ECOWAS member countries:

- National Institute of Agricultural Research of Benin (INRAB);
- Environment and Agricultural Research Institute (INERA), Burkina Faso;
- Ten institutes involved in agricultural research under the Council for Scientific and Industrial Research (CSIR)¹, Ghana;
- Senegalese Agricultural Research Institute (ISRA);
- Sierra Leone Agricultural Research Institute (SLARI); and
- Togolese Agricultural Research Institute (ITRA).

The assessment included a quantitative survey collecting information on human and financial resources, R&D infrastructure, and R&D outputs. A series of interviews and staff motivation surveys were carried out with selected researchers and managerial staff. The country-level outcomes of this in-depth assessment have been summarized in a series of country reports and country summary notes.² This current synthesis highlights the cross-cutting trends and challenges that emerged from the country-level data for West Africa, structuring it within five broad areas: funding capacity, human resource capacity, research outputs, research-related infrastructure, and institutional conditions—all in terms of whether they support or impede the effective and efficient conduct of agricultural R&D.

¹ These are the Animal Research Institute (ARI), Crops Research Institute (CRI), Soil Research Institute (SRI), Oil Palm Research Institute (OPRI), Food Research Institute (FRI), Forestry Research Institute of Ghana (FORIG), Plant Genetic Resources Research Institute (PGRRI), Savanna Agricultural Research Institute (SARI), Water Research Institute (WRI), and Science and Technology Policy Research Institute (STEPRI).

² Country-level reports and summary notes can be downloaded at ASTI's website: www.asti.cgiar.org/asti-coraf.

This report concludes with a set of national and regional policy recommendations for ECOWAS's Council of Ministers of Agriculture, national-level decision makers, and other stakeholders.

2. Challenges: R&D Funding

➤ Growth in agricultural R&D spending over time, but not everywhere and not quickly enough

Investments in public agricultural R&D in West Africa grew by more than 50 percent between 2000 and 2011, following two decades of nearly stagnant growth. This recent trend, however, is almost entirely driven by Nigeria and Ghana, and primarily stemmed from the urgent need to institute some degree of parity and competitiveness in researcher salary levels in both countries and—in the case of Nigeria—to rehabilitate derelict infrastructure and equipment. Investment levels in many other countries in the region, particularly the francophone countries, have either stagnated or fallen, although the data indicates an upsurge in spending levels in more recent years, largely in response of the launch of the West African Agricultural Productivity Program (WAAPP).

➤ Widespread underinvestment

Overall investment levels in most countries remain below the levels required to sustain viable agricultural R&D programs that address current and future priorities. In fact, almost all West African countries still fall short of the minimum target of 1 percent of AgGDP recommended by NEPAD and the United Nations (Table 2). 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. Policymakers are unable to extract immediate political credit from agricultural R&D investments and their benefits, and therefore have limited incentive to commit to such investments.

Table 2. Public agricultural research intensity ratios, 2000–2011

Country	Agricultural R&D spending as a share of AgGDP		
	2000	2008	2011
Benin	0.43%	0.60%	0.62%
Burkina Faso	0.80%	0.32%	0.42%
Cape Verde	na	1.26% ^a	1.12%
Côte d'Ivoire	0.70%	0.47%	0.49%
The Gambia	0.85%	0.67%	1.03%
Ghana	0.59%	0.61%	0.69%
Guinea	0.68%	0.15%	0.22%
Guinea-Bissau	na	0.04% ^a	0.02%
Liberia	na	0.39% ^a	0.42%
Mali	1.01%	0.51%	0.61%
Niger	0.19%	0.15%	na
Nigeria	0.21%	0.42%	0.33%
Senegal	0.97%	0.82%	0.83%
Sierra Leone	na	0.23%	0.21%
Togo	0.88%	0.40%	0.42%

Source: Compiled by authors from ASTI country factsheets.

Note: "na" denotes that data are unavailable.

a. 2009 data.

➤ Governments not always acting on their stated intentions and commitments

Although governments across West Africa are committed to funding agricultural R&D on face value, disbursed amounts are habitually lower than—and in many cases only a fraction of—budgeted allocations. The governments of Ghana and Senegal, for example, only disbursed 15 percent of the development budget originally allocated to CSIR agencies and ISRA during 2008–2012. It goes without saying that these funding discrepancies have severe

repercussions on the day-to-day operations of agricultural R&D institutes and their planned research activities based on anticipated funding levels.

➤ **Ongoing high levels of donor dependency**

In 2011, close to 30 percent of the funding to West African NARIs (excluding Nigeria) was derived from donors and development banks. Aside from the costs of salaries (which in most cases are entirely funded by national governments and represent the majority share of total R&D spending), donor funding for West African agricultural R&D would exceed 50 percent. Apart from being an uncertain funding source, high donor dependence has the potential side effect of skewing the research agenda away from national priorities.

➤ **Donor dependency as a major cause of yearly funding volatility**

Given that long period of time elapse between the inception of agricultural R&D and the adoption of resulting technologies, sustained and stable funding is necessary for the attainment of high research returns. Extreme volatility in yearly funding levels can have a severely negative impact on the continuity of R&D programs and on long-term research outputs. Detailed time-series data on agricultural R&D funding sources from across West Africa for the period 2001–2011 reveal that funding from donors and development banks has been much more volatile over time than has government funding. By definition, donor funding is short term and ad hoc. On average, institutes that are highly dependent on funding from donors and development banks are more vulnerable to funding shocks. Agricultural R&D funding in countries like Burkina Faso, Guinea, Sierra Leone, and Togo has been particularly volatile since the turn of the millennium.

➤ **WAAPP targets training and R&D infrastructure, not actual research**

At the same time, donor funding increasingly appears to be shifting to regional initiatives rather than national agricultural R&D programs. WAAPP is a sub-regional program co-financed through World Bank loans, a multi-donor trust fund, and national governments for the purpose of increasing the productivity of priority crops in West Africa. The program aims to facilitate regional cooperation in generating and disseminating agricultural technology and to establish national centers of specialization to strengthen the alignment of national and regional priorities. The project also funds demand-driven technology generation and adoption through a competitive funding scheme managed by CORAF/WECARD. WAAPP supports national agricultural R&D institutes mostly by rehabilitating laboratories and equipment for research on the identified priority crops and by investing in postgraduate training for young scientists (all of which is much-needed). Nevertheless, it should be noted that WAAPP funding for the actual operation of research programs is limited in most countries.

➤ **Disincentives to generate funding through the sale of goods and services**

Given low or nonexistent government funding for the operation of actual research programs, many institutes across West Africa have no choice but to seek alternative sources of funding such as through the sale of goods and services. In Benin, two-thirds of INRAB's program costs are funded through the sale of rice, maize, cowpea, and germinated palm oil seeds. In Ghana, CSIR institutes are mandated to generate a significant share of their financial resources through commercial means. Although this is a sound long-term goal, it is impeded in the short- to medium-term given the level of funding required, lack of capacity at CSIR to generate funds internally, as well as patent issues. Funding diversification through the sale of goods and services is not encouraged in all West African countries, however. ITRA in Togo reverted from a semiautonomous agency to a public agency in 2008, and with that change ceased to benefit from any revenues it generates internally. Similarly, INERA in Burkina Faso and INIDA in Cape Verde must transfer any funding they generate internally back to the Treasury. ARCN in Nigeria is only allowed to keep 30 percent of its internally generated income. The disincentive effect of such policies in these countries is a missed funding opportunity.

➤ **Lack of national competitive agricultural R&D funds**

Despite the popularity of competitive funding for agricultural R&D and innovation in other parts of the world, few West African countries have adopted competitive funding mechanisms as an instrument for allocating (and prioritizing) a portion of their national agricultural budgets to research and innovation. A notable exception is Burkina Faso, where

the National Innovation and Research and Development Fund (FONRID) has disbursed 500 million CFA per year on a competitive basis for (both agricultural and nonagricultural) R&D projects since 2011. Some competitive agricultural S&T funds were established around the turn of the millennium as components of World Bank projects in a number of West African countries, and more recently as part of WAAPP (for example, the National Agricultural and Food Research Fund [FNRAA] in Senegal). These funds finance R&D through grants allocated to projects on the basis of their scientific merit and their congruence with broadly defined agricultural R&D priorities. A main concern of these types of funding mechanisms is their long-term sustainability, given that so many of them are highly dependent on external funding—once the initial loan or grant has run its course, the competitive fund is exhausted as well.

3. Challenges: Human Resources

➤ Inadequate numbers of researchers, particularly in certain key disciplines

A minimal number of PhD-qualified researchers is generally considered fundamental to the conception, execution, and management of high-quality research and to communicating its results to policymakers, donors, and other stakeholders at national and regional levels. Despite the overall growth in the total number of agricultural researchers in West Africa, a number of countries have yet to achieve a critical mass, especially in the number of researchers with PhD degrees. The NARIs of The Gambia and Liberia employed only 6 and 5 researchers, respectively, with PhD degrees; none of the researchers at Guinea-Bissau have been trained to the PhD level. While the NARIs in Togo and Sierra Leone experienced an increase in the number of PhD-qualified researchers, actual numbers are still low relative to NARIs in neighboring countries. These institutes also have severe shortages of researchers trained in certain disciplines. Most NARIs predominantly employ crop and livestock scientists; other disciplines are often lacking sufficient capacity, including agricultural machinery, social sciences, animal health, natural resources management, biotechnology, and biometrics. ITRA has no maize, rice, or sorghum breeders or researchers in soil fertility, and the institute currently employs only one researcher focusing on animal health. WAAPP's training component aims to address these shortages, especially in the smaller countries where the gaps are the largest (see below). CSIR, in contrast, has a large number of agricultural researchers at its 10 institutes, and the overall composition of researchers by discipline is balanced, although some disciplines are limited at some of the institutes.

➤ Aging pools of researchers, particularly at the PhD level

Long-term public-sector recruitment restrictions have left institutes in many countries with an aging pool of agricultural researchers, many of whom are set to retire within the next decade. On average, more than half the agricultural scientists in West Africa with PhD degrees were more than 50 years old in 2011 (Table 3). In Guinea, Liberia, Mali, Sierra Leone, and Togo, the situation is even more alarming, with more than 70 percent of PhD-qualified researchers being more than 50 years old. An official retirement age of either 60 or 65 years only puts further pressure on already inadequate researcher capacities in most countries. This is particularly grave in disciplines that are already severely underrepresented: INRAB in Benin, for example, employs only one plant breeder who is close to retirement and who has no assistant to train as a replacement. To (temporarily) address this issue, the Senegalese government recently increased the official retirement age for ISRA's researchers from 60 to 65 years. While this is sound policy under the circumstances, it won't solve the succession issue longer term without increased recruitment and training.

Table 3. Aging of agricultural researchers, 2011

Country	Share of researchers older than 50 years (%)		Official retirement age (years)
	Total	PhD	
Benin	51	57	60 for government agencies/ 65 for higher education agencies
Burkina Faso	25	29	65
Cape Verde	24	50	65
The Gambia	33	47	60
Ghana	35	60	60

Guinea	74	95	60 for women / 65 for men
Guinea-Bissau	67	—	60
Liberia	25	71	60
Mali	46	82	65
Nigeria	19	54	65
Senegal	42	38	65
Sierra Leone	26	74	65
Togo	60	71	60 for government agencies/ 65 for higher education agencies

Source: Compiled by authors from ASTI country factsheets.

Notes: Age data were unavailable for Côte d'Ivoire and Niger and exclude the higher education sector for Burkina Faso and Senegal. Nigeria only includes the 15 institutes affiliated with the Agricultural Research Council of Nigeria (ARCN).

➤ Female researchers severely underrepresented

Female researchers offer unique insights, perspectives, and skills that can help research institutions more effectively address the specific challenges of farmers in Africa, the majority of whom are female. Furthermore, attracting women into agricultural research would be a highly beneficial strategy for addressing the aforementioned low researcher capacity in many countries. Despite increases in the shares of female researchers over time in most countries, female participation in agricultural R&D in West Africa remains very low compared with other African subregions, and with the rest of the world. Moreover, the roles, status, and ability of female researchers to participate in decision making processes remain limited. Female participation is particularly low in Guinea-Bissau (0 percent), Guinea (4 percent), and Togo (9 percent; Table 4). In addition, female scientists are far less likely to hold PhD degrees than their male colleagues, so West Africa still has a long way to go in increasing female participation in agricultural R&D and hence integrating gender perspectives into the formulation of related policies. On a positive note, the share of female researchers has increased in most West African countries during 2008–2011.

Table 4. Share of female researchers, 2011 compared with 2008

Country	Share of female researchers by degree, 2011 (%)			Share of female researchers (%)	
	PhD	MSc	BSc	2011	2008
Benin	10	15	0	12	15
Burkina Faso	7	15	13	11	13
Cape Verde	50	38	33	38	na
The Gambia	—	16	14	14	11
Ghana	15	21	21	19	16
Guinea	0	5	5	4	5
Guinea-Bissau	—	—	—	—	na
Liberia	2	40	16	20	na
Mali	8	15	80	22	10
Nigeria	19	34	30	29	27
Senegal	19	15	40	19	10
Sierra Leone	7	17	9	14	6
Togo	na	na	na	9	na

Source: Compiled by authors from ASTI data.

Notes: Data on the share of female researchers were not available for Côte d'Ivoire and Niger and exclude the higher education sector for Senegal. Nigeria only includes the 15 institutes affiliated with the Agricultural Research Council of Nigeria (ARCN). "na" denotes that data were unavailable.

➤ Poor incentive structures for researchers resulting in high staff turnover

Many NARIs are challenged in their ability to compete with universities, the private sector, and other organizations when it comes to recruiting, retaining, and motivating well-qualified researchers. Key issues include low salaries and

poor benefit and retirement packages; limited promotional opportunities and work flexibility (for example, in terms of working hours or opportunities to collaborate with other agencies); lack of infrastructure, services, and equipment; and poor management structures. For example, many well-qualified researchers have left INRAB in recent years as a result of the large differences in salary levels and benefit packages between INRAB and the higher education sector and international organizations. INERA lost 40 PhD-qualified researchers during 2006–2011, most of whom departed for more lucrative opportunities elsewhere. To halt the high rates of staff attrition, various NARIs increase salary levels with government support to improve incentives. For example, the Senegalese government has increased the salary levels of ISRA's researchers by over 100 percent and improved their promotional opportunities. The government of Ghana instituted the "Single Spine Pay Policy," which introduced parity between the salaries of CSIR scientists and those of university-based scientists. Staff morale has improved considerably at both institutes, the supply of candidates for vacant positions has increased, and staff departures appear to have declined.

➤ **Limited access to in-country postgraduate training**

The provision of postgraduate (PhD and MSc) training programs at national universities is limited in many West African countries. For example, SLARI's human resource plan recommended that the institute focuses on recruiting MSc-qualified researchers, but most graduates from national universities hold only BSc degrees. Many NARIs do not have plans addressing their human resources and training needs. Furthermore, most governments do not allocate funding to train researchers; training generally depends on donor funding, which has been increasingly scarce in the past few decades. The large capacity strengthening components of WAAPP will address this to some degree in countries that have experienced growing skill gaps and limited training opportunities. In 2012–2013, 26, 30, and 38 researchers in Burkina Faso, Togo, and Sierra Leone, respectively, received grants to pursue MSc- or PhD-degree training at universities in their own countries or elsewhere in West Africa. One short-term downside of this massive training effort is that the institutes are operating with an even more limited pool of researchers while those undertaking training are away. WAAPP also supports training through exchange programs with researchers of other West African countries, as well as regional and international organizations. These large training components under WAAPP also have a positive impact on staff morale, motivation, and career opportunities. A further downside, however, is the potential to increase staff attrition as more highly qualified and experienced researchers become more attractive to the other agencies, and researchers are motivated to seek more attractive salaries benefits, and conditions. This can be dealt with to some degree through training stipulations that require a commitment from researchers for a definitive period once they complete their training.

4. Challenges: R&D Outputs

➤ **Low scientific output of research institutes**

In 2008, SSA (excluding South Africa) represented just 0.6 percent of global scientific publications, and this share has been relatively consistent over the past decade.³ The scientific output of agricultural research institutes across West Africa is very low as well. In 2012, 68 ISRA researchers produced a combined 32 journal articles, books, or book chapters, resulting in a publication-per-researcher ratio of just 0.47 that year. The average number of scientific publications per researcher produced by the other NARIs was even lower, ranging from just 0.01 at ITRA to 0.41 at INRAB.⁴ The fact that scientific output remains so low despite the increased availability of funding over the years is a major cause for concern. Research institutes with a track record of high-quality research and publications are more likely to generate funding through competitive funds or engage in high-profile collaborative projects with scientific partners in the developed world. Nonetheless, most West African agricultural research institutes provide insufficient incentives for their scientists to publish. Few agricultural research institutes assess the performance of their scientists

³ UNESCO (United Nations Educational, Scientific and Cultural Organisation). 2010. Accessed June 2014. <http://unesdoc.unesco.org/images/0018/001899/189958e.pdf>.

⁴ These data are for 2012. The total number of publications can fluctuate considerably from one year to the next.

based on the number of publications they produce. Moreover, given that so few researchers are used to publishing in renowned journals, many actually lack the expertise and technical writing skills needed to be accepted for publication in academic or journal articles and other forums.

➤ **Limited innovative capacity of smaller national agricultural research systems**

The release of new varieties and technologies reflects the extent to which agricultural research institutes fulfill their mandates and respond to the needs of their end users (that is, farmers). The number of varieties released in West Africa varied greatly among NARIs. INERA and CSIR released a steady flow of new varieties during 2008–2012 (Table 5). In contrast, ITRA adapted just two rice varieties (developed by AfricaRice) and developed no new varieties in-house during this period, whereas INRAB developed just one cotton and one maize variety in-house and adapted two maize varieties developed by the International Maize and Wheat Improvement Center (CIMMYT). The low innovative capacity of these institutes is a reason for concern, raising questions as to the effectiveness of national agricultural R&D outputs, and whether these countries would not be better served by focusing on (and potentially contributing to) technology spill-ins in from their larger neighbors. Weak domestic intellectual property rights legislation remains a challenge across West Africa and can also be seen as a factor impeding innovation; many countries struggle with how to reconcile intellectual property rights with farmers' rights and other local interests, which is a valid concern. Of the six NARIs under study, INERA is the only one that succeeded in protecting some of its improved varieties (two cotton and two sorghum varieties) with the African Organization of Intellectual Property (OAPI). Increased regionalization of agricultural research in West Africa through WAAPP raises complex intellectual property rights issues that need to be resolved.

Table 5. Number of improved crop varieties developed or adapted by NARIs, 2008–2012

NARI	Number of improved crop varieties developed in-house by NARI	Externally developed crop varieties tested and adapted by NARI	Crops
INRAB	2	2	Cotton, maize
INERA	64	43	Millet, cotton, soy, maize, rice, sorghum, other
CSIR	47	2	Rice, maize, groundnuts, sweetpotatoes, cowpeas, soy, and oil palm
ISRA	9	30	Rice, sesame, maize, millet, sorghum, and cowpeas
SLARI	6	7	Rice, cassava, sweetpotatoes, groundnuts, and cowpeas
ITRA	0	2	Rice

Source: Compiled by authors from ASTI/IFPRI–CORAF/WECARD survey data.

5. Challenges: R&D Infrastructure

➤ **Outdated research infrastructure impedes the conduct of productive research**

One of the principal reasons for the relatively limited scientific output of West African agricultural research institutes is the lack of adequate research infrastructure and equipment. ITRA has numerous laboratories that are not operational because of the dilapidated state of their equipment and infrastructure (this includes ITRA's entomology and phytopathology/virology laboratories, as well as its animal research unit). INRAB also has two defunct laboratories for similar reasons, and although its center serving the north of the country is still in operation, it lack access to electricity, raising questions as to the effectiveness of its research. NARIs in Burkina Faso, Senegal, and Sierra Leone all reported similar challenges to their research efforts due to outdated research infrastructure; equipment that has gone into disrepair; insufficient access to vehicles to conduct field research; frequent power cuts that disrupt trials; unreliable Internet access; and a lack of up-to-date hardware, software, and servers. CSIR considered most of its laboratories adequate, but issues have been raised related to the need for maintenance and upgrades. It goes without saying that outdated agricultural R&D infrastructure has a significant detrimental impact on the quantity and quality of research outputs in West Africa.

➤ **WAAPP-supported infrastructure upgrades only target priority commodities**

The rehabilitation of research infrastructure is one of the key objectives of WAAPP. Currently, research stations and laboratories, offices, field infrastructure, and staff residences are being upgraded across West Africa with WAAPP support. WAAPP is also addressing electricity, Internet access, and staff mobility challenges by investing in broadband Internet, generators, and vehicles. Despite these much-needed investments, much more is needed. WAAPP funding is predominantly targeted to upgrades of centers and stations focusing on preselected priority commodities, and largely overlooks many other centers and stations that are in urgent need of rehabilitation as well.

➤ **Lack of staff training on the operation of R&D equipment impedes its use**

Many donors fund the rehabilitation of research infrastructure and equipment, but often fail to provide training to researchers and technicians on how to operate new equipment. For example, the West African Economic and Monetary Union (UEMOA) has invested heavily in upgrading biosecurity research infrastructure in member countries as part of the development of a common biosecurity policy for West Africa. In all UEMOA member countries, biosecurity laboratories have been renovated and equipped with multi-million dollar state-of-the-art technology. However, much of the new equipment remains unused because researchers and technicians were not given appropriate training on how to operate (and maintain) it and hence prefer to work with the old equipment instead. Moreover, despite the inflow of these technologies, in the absence of funding and hence projects requiring its use, these technologies are rendered idle.

CHALLENGES: INSTITUTIONAL STRUCTURE OF AGRICULTURAL R&D

➤ **Lack of (semi)autonomous status or reporting to an entity other than Ministry of Agriculture**

Most NARIs in West Africa are administered by the ministry of agriculture or the ministry of science and technology, and receive most of their funding from the government (often through the ministry of finance). A number of NARIs still do not have (semi)autonomous status, and as such are limited in their ability to set their own financial, human resource, or other operating policies as a means of diversifying their funding sources, offering competitive working conditions, and more generally becoming more efficient. Larger countries like Ghana and Nigeria have adopted a council model, which should facilitate coordination, but collaboration among institutes remains limited. Even though many NARIs have some degree of autonomy, lack of funding prevents them from exercising this autonomy. In Benin and Togo, for example, the ministry of agriculture can second experienced researchers to other ministerial departments at will; INRAB and ITRA have little to say on this issue and lose much-needed expertise this way each year. INERA falls under the Ministry of Higher Education and Scientific Research rather than the Ministry of Agriculture. This is often seen as a major impediment to effective linkages with the end users of its research. In Senegal, research coordination is too dispersed across ministries, and linkages between ministries are generally seen as weak, often leading to duplication of research activities. The coordination of scientific research at the ministerial level underwent considerable restructuring at frequent intervals in recent years, but lack of policy continuity is widely seen as having a damaging effect on the effectiveness of research.

➤ **Lack of strategic planning within many national agricultural research institutes**

Many NARIs in West Africa have outdated or nonexistent long-term strategic plans and accompanying operational plans. For example, council-level strategic planning at CSIR remains limited, and the most recent plan (for 2005–2009) has long been outdated. With the assistance of FARA, SLARI developed a set of strategic, operational, and investment plans during 2011–2012. However the costs of implementing the first operational plan exceeds the funding levels expected from government, donor, and private sector sources, resulting in an estimated shortfall of 60 percent. In addition, planning and monitoring and evaluation capacity is weak across West Africa. Many countries lack efficient administration systems and practices. Data management at INERA, for example, is weak, with each center managing its own financial and human resource databases. Donor funding is often disbursed directly to the centers without passing through headquarters, and without the knowledge of the director of finance. Many researchers officially listed as being on INERA's payroll by the administration do not work at the institute, but instead are from other ministerial divisions. This understandably impedes effective human resource management.

➤ **Weak linkages between research and extension impede the adoption of improved varieties**

The lack of a close working relationship between NARIs and extension agencies, and with farmer organizations, is one of the most difficult institutional problems confronting agricultural R&D in West Africa. In many countries (formal) extension agencies are extremely weak or non-existent, and where they do exist, they often compete with research agencies for the same scarce government resources. In Ghana, the Research–Extension–Farmer Linkage Committees (RELCs) were established to encourage demand-oriented research involving farmers with the goal of enhancing farming practices and productivity. In reality, however, the RELCs perform steering rather than implementation functions, so the dynamic interface to promote technology transfer has not been realized.

6. Conclusions and Policy Options

Well-developed national agricultural research systems and adequate levels of investment and human resource capacities are prerequisites in the attainment of agricultural development, food security, and poverty reduction. Some encouraging signs indicate that African countries have become increasingly focused on investing in agriculture for economic growth in recent years, evidenced by a number of influential initiatives and regional and subregional processes that have put agriculture and agricultural R&D firmly back on political and donor agendas. Many countries have developed solid agricultural development and financing plans to strengthen agricultural production and food security as part of CAADP. Another important move toward a stronger agricultural sector is the Science Agenda for Agriculture in Africa (S3A), which was initiated in early 2013.

Despite this increased political support to agricultural R&D, West Africa is still severely lagging behind other parts of Africa when it comes to agricultural R&D capacity and investment. Compared with other African regions, West Africa invests a substantially smaller share of its AgGDP in agricultural research, is more dependent on volatile donor funding, and employs both a much older pool of scientists (many of whom are approaching retirement age, can we provide %) and a much smaller share of female agricultural scientists. Moreover, West Africa is severely challenged in terms of R&D infrastructure. Outdated research equipment and facilities are impeding the conduct of productive research, which compromises the number and quality of research outputs and ultimately translates into reduced impact.

Success in achieving ambitious future agricultural growth targets set by CAADP and the United Nations is intrinsically dependent on sufficient and stable financial resources for agricultural R&D and the development of adequate human resource and institutional capacity. The apparent recent increase in political support to agricultural R&D must be translated into a clear set of policy directives by governments if the many challenges facing agricultural R&D systems are to be addressed. Taking into account the various challenges related to agricultural R&D funding, human capacity, outputs, infrastructure, and institutional structure presented in this report, policy implications for West African governments are indicated in the key areas outlined below.

➤ ***Governments must address underinvestment in agricultural R&D and take the necessary policy steps to diversify funding sources***

Evidence does not indicate significant improvement in the relative intensity of agricultural research investment (agricultural R&D spending as a share of AgGDP) in West Africa over time. Despite CAADP's efforts to promote stronger investment in agriculture (including agricultural research) across the region, as well as increased allocations to agricultural research by a number of West African governments in recent years, agricultural R&D spending in most West African countries is still far below the levels required to sustain their agricultural sectors' needs. Countries that have increased their expenditures substantially, such as Ghana and Nigeria, have directed most of the funds toward (much-needed) salary increases, rather than actual research programs. National governments urgently need to address underinvestment in agricultural R&D and ensure the full disbursement of approved budgets. They must provide stable and sustainable levels of funding to secure a strategic program of effective research activities that yields increased agricultural productivity.

Rather than relying too much on donor contributions and development bank loans to fund critical areas of research, governments need to determine their own long-term national priorities and design relevant, focused, and coherent agricultural R&D programs accordingly. Donor and development bank funding needs to be closely aligned with national priorities, and donor programs should synergistically complement these priorities. Mitigating the effects of any single donor's abrupt change in aid disbursement is crucial, highlighting the need for greater funding diversification—for example, through the sale of goods and services, or by attracting complementary investment from the private sector. The private sector is currently the least developed source of sustainable financing for agricultural R&D in West Africa (its funding potential remains largely untapped in most countries). Cultivating private funding requires that national governments provide a more enabling policy environment through tax incentives, protection of intellectual property rights, and regulatory reforms to encourage the spill-in of international technology.

➤ ***Governments must invest in training and capacity building and remove status and salary discrepancies between NARI researchers and university-based researchers.***

Few NARIs in West Africa have autonomous status in setting their own financial, human resource, or operating policies, which limits their ability to diversify their funding sources, offer competitive salaries and working conditions, and generally maximize efficiency levels. Growing concern exists regarding the lack of human resource capacity in agricultural R&D to respond effectively to the challenges that agriculture in West Africa is facing. In nearly all countries in West Africa, the majority of PhD-qualified researchers will retire by 2025. NARIs therefore need to develop systematic human resource strategies without delay, incorporating existing and anticipated skills gaps and training needs. The successful implementation of such strategies will require both political and financial support. National governments must expand their investments in agricultural higher education to allow universities to increase the number and size of their MSc and PhD programs—or establish such programs in countries where MSc and PhD programs are still lacking—and to improve the curricula of existing programs. This includes the expansion of various regional capacity-building initiatives initiated in recent years, including those under WAAPP. In addition to degree-level training, NARIs should involve present and past tenured researchers in mentoring their younger colleagues. In some countries, this may involve increasing the official retirement age of researchers or instituting some form of flexible working arrangements for retired researchers. Developing incentives to create a more conducive work environment for agricultural researchers is crucial. In a large number of countries, significant discrepancies exist in the remuneration, working conditions, and incentives offered to NARI researchers compared with their university-based colleagues. These inequities need to be removed or overcome to enable the NARIs to attract, retain, and motivate well-qualified researchers.

➤ ***Governments must develop long-term national agricultural research policy agendas and provide stronger institutional, financial, and infrastructural support to NARIs***

Although many NARIs in West Africa have (semi)autonomous status, funding and capacity constraints often prevent them from exercising this autonomy. Most NARIs are bound by ministerial directives and regulations, and therefore have little or no flexibility in recruiting staff, setting competitive salary levels, or determining what laboratories need renovation—all of which are needed to strengthen NARIs institutionally and ensure the continuity of their research. A critical area needing urgent attention is the development of strong, national agricultural research policy agendas, together with the necessary expertise to support these agendas long term. It is also essential that governments strengthen the institutional, financial, and infrastructural foundations of NARIs so they can more effectively address farm productivity challenges and poverty issues. Strengthening the planning capacity at the research program level is crucial to the overall effectiveness of NARIs. Many NARIs currently lack efficient administration systems and practices needed to more effectively monitor progress and inform strategic decision-making.

Governments will also need to provide the necessary policy environment to stimulate cooperation among the country's agricultural R&D agencies in order to maximize synergies and efficiencies in the use of the scarce resources available to universities and government agencies. In addition, governments must take action to ensure that improved varieties and technologies released by the NARIs are disseminated to and adopted by farmers. This involves strengthening extension agencies and more clearly delineating the roles of NARIs and extension agencies to actively promote cooperation. Gender considerations also need to be taken into account in terms of identifying gender-specific research needs, designing training programs, and determining criteria for technology development and adaptation.





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