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STAFF AGING AND TURNOVER IN AFRICAN AGRICULTURAL R&D

Lessons from Five National Agricultural Research Institutes

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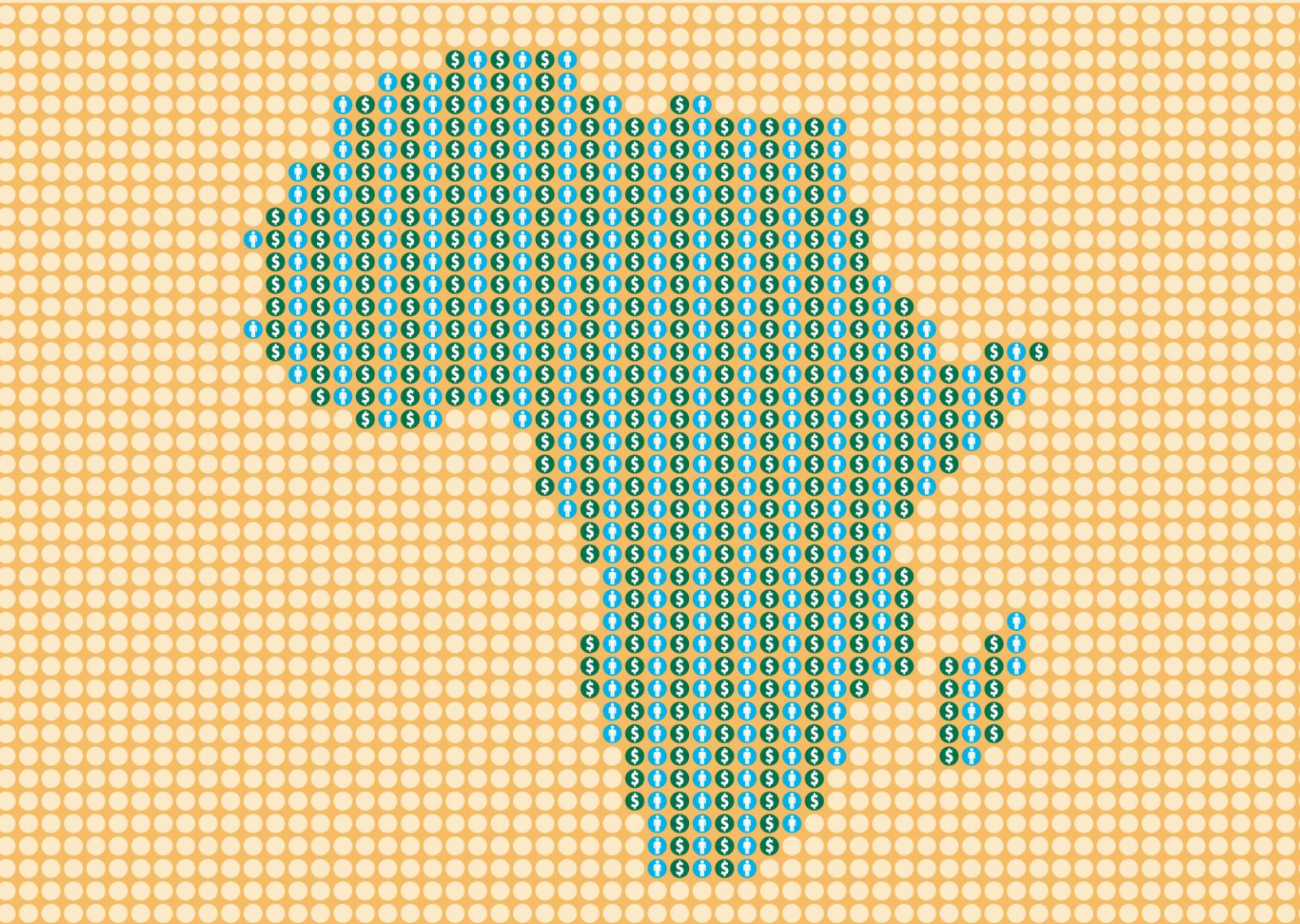
AGRICULTURAL R&D: INVESTING IN AFRICA'S FUTURE
Analyzing Trends, Challenges, and Opportunities



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Acronyms and Abbreviations

ARC	Agricultural Research Council (South Africa)
ASTI	Agricultural Science and Technology Indicators
EAAPP	East African Agricultural Productivity Program
FTE	full-time equivalent
INERA	*Institut de l'Environment et de Recherches Agricoles* [Environment and Agricultural Research Institute]
ISRA	*Institut Sénégalais de Recherches Agricoles* [Senegalese Agricultural Research Institute]
KAPAP	Kenya Agricultural Productivity and Agribusiness Project
KARI	Kenya Agricultural Research Institute
NARI(s)	national agricultural research institute(s)
NGO(s)	nongovernmental organization(s)
R&D	research and development
SSA	Sub-Saharan Africa
WAAPP	West African Agricultural Productivity Program
ZARI	Zambia Agricultural Research Institute

Abstract

This paper synthesizes the results of five national case studies conducted from May to July 2011 for the purpose of analyzing the scope and magnitude of the human resource challenges facing national agricultural research institutes in Africa. The intention was to gather information on how other countries have tackled these challenges and to provide suggestions on strategies that work within specific country contexts. It is hoped that both the institutes in questions, as well those in other African countries, will be able to draw valuable lessons from this research.

1. INTRODUCTION

Agricultural growth is essential to improving human welfare in Africa, given that 70 percent of all Africans and nearly 90 percent of Africa's poor people primarily work in agriculture (World Bank 2000). Roughly 80 percent of the population lives in rural areas, and even those who do not depend heavily on agricultural productivity growth and the development of agriculture-based value chains to create livelihood opportunities that can lift them out of poverty. Given agriculture's dominant contribution to African livelihoods and economic development, effective agricultural research and development (R&D) is vital to the process of strategically addressing the many and varied constraints to agriculture, particularly in Sub-Saharan Africa (SSA). Furthermore, the foundation of agricultural research systems, and the institutions that constitute them, is human resource capacity. New technologies and innovations not only need to be created, developed, and adapted, but also disseminated and successfully adopted. This process can go nowhere without well-trained, highly skilled and creative personnel within an enabling environment that offers the resources, support, and appropriate motivation.

Unfortunately, many public agricultural research systems in SSA have been dealing with reduced recruitment due to structural adjustment programs and lack of funding, resulting in an aging population of researchers, and in some cases a disproportionate number of newly hired junior researchers. Poor conditions at many institutions have made attracting and retaining highly qualified staff extremely difficult, and this has only been exacerbated by a lack of training and other opportunities necessary to enable the advancement of younger scientists. Building and maintaining a pool of well-qualified researchers is an even more serious problem in the many small countries of SSA, further emphasizing the importance and value of regional initiatives that maximize economies of scope and scale in dealing with the unique needs and vulnerabilities of such countries.

Against this background, the Agricultural Science and Technology Indicators (ASTI) initiative commissioned five case studies in collaboration with its national partners to assess the status of and trends in human resource capacity within the national agricultural research institutes (NARIs) of Burkina Faso, Kenya, Senegal, South Africa, and Zambia. This paper synthesizes the main findings of those case studies with the intention of drawing lessons both for the countries in question and for other countries and development initiatives within the region.

2. BACKGROUND

The five study countries were selected through an overall assessment of the state of human resources within the NARIs of the 32 SSA countries for which ASTI has appropriate data. The five NARIs selected were Burkina Faso' Environment and Agricultural Research Institute (INERA), the Kenya Agricultural Research Institute (KARI), the Senegalese Agricultural Research Institute (ISRA), South Africa's Agricultural Research Council (ARC), and the Zambia Agricultural Research Institute (ZARI). A reference period of 2001–10 was chosen, and the study team developed a standard list of research questions. Most of the human resource data, such as number of researchers by degree, gender, and age and number of support staff by gender and age, were available through the Institutes' headquarters, although not always in the form needed for the study. Additional data on issues such as the main reasons researchers had resigned and suggestions on how to improve human resource development were collected through a questionnaire and interviews with researchers, including those who had been newly recruited and those who had recently resigned or retired. A literature review was also conducted by the case study representative for each country in order to complete information.

The five NARIs are all government-based agencies, but they understandably have different mandates (Table 1). Research at INERA and ZARI focuses only on crops, whereas at KARI and ARC it focuses on crops and livestock; forestry and fisheries research in all four of the countries are conducted

at specialized government agencies. In contrast, ISRA's mandate comprises all four main research areas. In addition, various NARIs also conduct substantial research in other areas, such as natural resources (ARC, KARI, and INERA), agricultural engineering (ARC and ZARI), and socioeconomics (ISRA, KARI, and INERA).

Table 1. The five NARIs compared

		Mandate		Share in country's public agricultural research, 2008	
NARI	Country	Major area	Other areas	Researchers (%)	Spending (%)
ARC	South Africa	Crops and livestock	Engineering, natural resources, postharvest	58	55
INERA	Burkina Faso	Crops and livestock	Natural resources, socioeconomics	72	72
ISRA	Senegal	Crops, livestock, forestry, fisheries	Socioeconomics	69	71
KARI	Kenya	Crops and livestock	Natural resources, socioeconomics	53	49
ZARI	Zambia	Crops	Engineering	62	43

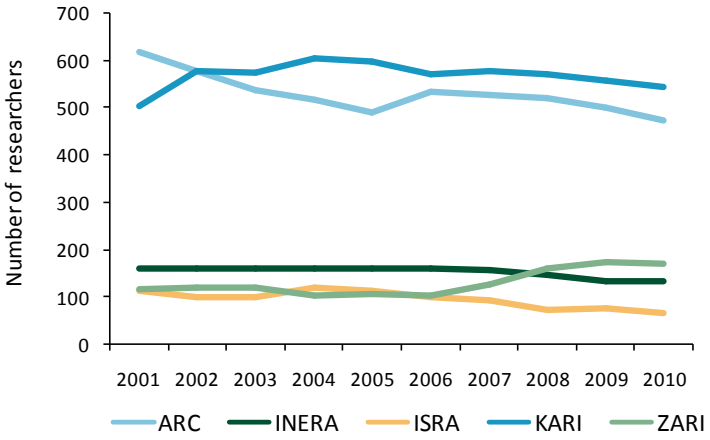
Source: ASTI database.

The five NARIs also differ in terms of their research capacity, measured in numbers of full-time equivalent (FTE) researchers and total R&D spending, as well as their relative contribution to national agricultural R&D. In 2008, ARC and KARI employed roughly four or five times more researchers than either ISRA or ZARI. Relative spending levels differed widely: in 2008 ARC spent twice as much as KARI, about 10 times as much as INERA and ISRA, and more than 40 times as much as ZARI. Given the increased importance of other research agencies, particularly those in the higher education sector, the NARIs' shares of the total public agricultural R&D declined in many African countries (Beintema and Stads 2011). Nevertheless, in 2008 the five NARIs under study employ the largest shares of their country's pool of public agricultural researchers, ranging from 53 percent in Kenya to 72 percent in Burkina Faso.

3. GENERAL TRENDS

Time-series data on the total number of scientists were available for all five countries, and included detailed information on gender and age distribution. During the period under study, the number of researchers employed at ARC declined substantially. Despite a slight rebound in 2006, numbers fell from 620 FTEs in 2001 to 474 in 2010. The reduction stemmed from institutional restructuring combined with staff dissatisfaction and the opening up of new opportunities at the universities given their increased involvement in agricultural research. Recruitment efforts were instigated during 2004–07 in response to the high resignation rates of the first half of the decade, presumably explaining the spike in numbers in 2006. Researcher numbers at ISRA followed a similar trend, falling from 114 FTEs in 2001 to 67 in 2010. This decline partly stemmed from the draw of university and private-sector opportunities, but it was also caused by the retirement of researchers. Total researcher numbers actually increased slightly at KARI and INERA, but growth was uneven over the 10-year period. At KARI this was the result of the 2003 merger of two institutes followed by the detachment of another institute from KARI in 2009. Total scientist levels at INERA declined slightly after 2004, when a large World Bank loan–funded project concluded. Like most of the region's NARIs, at ZARI total researcher numbers declined somewhat in the first half of the decade due to a civil service hiring freeze that was lifted in 2007. Numbers contracted from 117 FTEs in 2001 to 102 in 2006, thereafter increasing substantially to 171 in 2010.

Figure 1. NARI researcher levels, 2001–10



Sources: Compiled by authors from Liebenberg (2011); Kaboré, Ouédraogo, and San (2011); Mwala and Mwale (2011); Murithi and Minayo (2011); and Sène (2011).

Overall, SSA's total number of agricultural researchers increased from 9,841 FTEs in 2001 to 12,120 FTEs in 2008. Country-level data, however, show that this growth was largely driven by only a few countries, including Nigeria, Ethiopia, Sudan, and Kenya. Importantly, in some countries increased human resource capacity was largely due to growth of research in the higher education sector rather than growth within the NARIs (Beintema and Stads 2011).

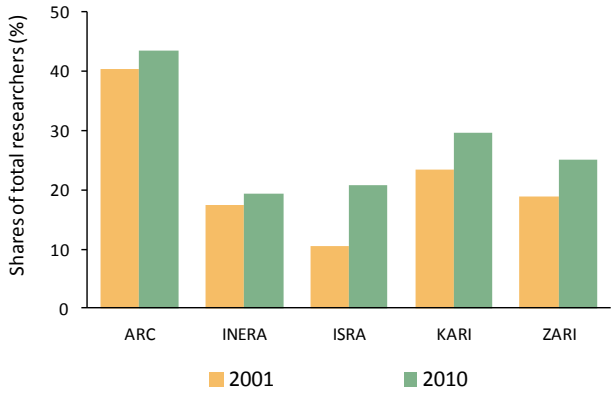
The share of female agricultural researchers increased at all five NARIs during 2001–10, in some cases due to notable increases in the number of female researchers employed, and in others due to significant declines in the number of male researchers employed (Table 2, Figure 2). Together, the NARIs employed 451 female researchers in 2010 (245 excluding ARC) compared with 430 in 2001 (180 excluding ARC). By comparison, the combined number of male researchers employed at the five institutes was 1,087 in 2001 (717 excluding ARC) and 940 in 2010 (672 excluding ARC). The number of female researchers employed at ARC declined by 44 individuals over the 10-year period, compared with a decline of 102 male researchers. As a result, the ratio of female to male researchers grew from 40 percent in 2001 to 43 percent in 2010. Shares of female researchers at the other four agencies, despite notable improvements, were lower. At KARI the share of women increased from 25 to 30 percent, at ZARI it increased from 19 to 25 percent, at ISRA it increased from 11 to 21 percent at ISRA, and at INERA it grew substantially from 5 to 19 percent. With the exception of INERA, whose share of female researchers remains among the lowest in SSA, the ratios equaled or bettered the regional average of 22 percent (Beintema and Rahija 2011).

Table 2. Researcher numbers by gender, 2001–10

NARI	Gender	Year 2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	10 year average
ARC, South Africa	Male	370	339	305	294	296	318	309	302	286	268	309
	Female	250	239	234	223	196	216	218	218	215	206	222
	Total	**620**	**578**	**539**	**517**	**492**	**534**	**527**	**520**	**501**	**474**	**530**
INERA, Burkina Faso	Male	133	133	131	132	133	132	131	122	107	108	126
	Female	28	28	28	28	28	28	26	26	26	26	27
	Total	**161**	**161**	**159**	**160**	**161**	**160**	**157**	**148**	**133**	**134**	**153**
ISRA, Senegal	Male	102	91	92	111	100	91	83	73	62	53	86
	Female	12	10	9	9	14	10	8	8	14	14	11
	Total	**114**	**101**	**101**	**120**	**114**	**101**	**91**	**81**	**76**	**67**	**97**
KARI, Kenya	Male	387	427	417	429	418	399	403	399	389	383	405
	Female	118	151	159	176	179	172	174	172	168	162	163
	Total	**505**	**578**	**576**	**605**	**597**	**571**	**577**	**571**	**557**	**545**	**568**
ZARI, Zambia	Male	95	99	97	81	79	75	97	119	137	128	101
	Female	22	21	21	22	26	27	31	41	37	43	29
	Total	**117**	**120**	**118**	**103**	**105**	**102**	**128**	**160**	**174**	**171**	**130**

Sources: Compiled by authors from Liebenberg (2011); Kaboré, Ouédraogo, and San (2011); Mwala and Mwale (2011); Murithi and Minayo (2011); and Sène (2011).
Note: Researcher numbers differ for some years from those published by ASTI due to differences in definitions.

Figure 2. Shares of female researchers, 2001 and 2010



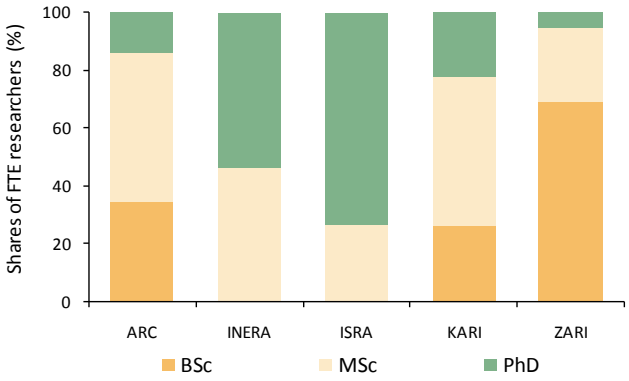
Source: Compiled by authors from data underlying Liebenberg (2011), Mwala and Mwale (2011), Murithi and Minayo (2011), Sène (2011), and Stads and Kaboré (2010).
Note: Data for INERA are for 2008, based on ASTI surveys.

The five NARIs also differ substantially in terms of the qualifications of their researchers.[1] Consistent with institutional trends in other West African countries, researchers employed at INERA and ISRA are more highly educated in general than those employed at ARC, KARI, or ZARI (Figure 3). At ISRA, this is partly because staff with BSc or equivalent degrees are not classified as researchers, but rather as technicians/support staff. Moreover, since 1999 newly recruited researchers at ISRA are required to be qualified to the PhD degree or equivalent level; staff with only BSc or MSc degrees are classified as research support. In part due to the change in classification, this group grew in number from 76 in 2001 to 106 in 2008 (Stads and Sène 2010). It is striking, however, that both agencies have maintained a high

[1] Note that under the francophone system, *doctorat* is equivalent to a PhD degree, DEA is equivalent to an MSc degree, and DUT and BTS are equivalent to BSc degrees.

level of well-qualified researchers and research support staff despite declining financial resources and overall researcher numbers. In 2010, 73 and 53 percent of researchers at ISRA and INERA, respectively, held PhD degrees. In contrast, PhD-qualified researchers accounted for only 14 and 5 percent of the total pool of researchers at ARC and ZARI. Such low levels of highly qualified researchers are understandably worrisome. In addition, in 2010 ZARI's staff comprised a high proportion of researchers qualified to the BSc level only.

Figure 3. Distribution of researchers by degree level, 2010



Sources: Compiled by authors from data underlying Liebenberg (2011), Mwala and Mwale (2011), Murithi and Minayo (2011), Sène (2011), and Stads and Kaboré (2010).
Note: Data for INERA are for 2008, based on ASTI surveys. Data for ARC include both researchers and research support staff (that is, PhD-qualified, as well as MSc- and BSc-qualified, research staff).

The distribution of researchers by academic discipline is constantly changing with the departure and recruitment of staff, and as researchers pursue higher degree qualifications, but since no uniform categories are used across the five NARIs it is difficult to make comparisons. In 2010, of ARC's researchers, 25 percent were trained in crop health (weeds, pathology, and entomology), 12 percent in veterinary sciences, 8 percent in natural resources, and 6 percent in crop breeding (food crops, horticulture, and industrial crops). Other academic disciplines, such as biotechnology and sociology, were less common, and the mix had changed little since 2001. At ISRA, 47 percent of the researchers were trained in crop sciences, followed by animal and livestock sciences (18 percent), forestry and agroforestry (12 percent), fisheries and aquatic resources (10 percent), and agricultural economics (7 percent). Newer academic disciplines, such as molecular biology and biotechnology, accounted for 3 and 2 percent, respectively. KARI had a higher share of researchers trained in crop sciences (agronomy, breeding, health, and postharvest for food and horticulture crops), followed by livestock (nutrition, management, breeding, and veterinary sciences), and natural resource management. KARI also had a large pool of socioeconomists and statisticians (agricultural economists, sociologists, anthropologists, and biometricians) compared with the other NARIs in the sample.

4. DISTRIBUTION OF RESEARCHERS BY AGE

Data on researchers by age and gender and by age and degree were available for four of the NARIs under study. In 2010, the average age of researchers was 40 years at ZARI, 43 years at ARC, 45 years at KARI, and 50 years at ISRA (Table 3). Male researchers at ISRA and KARI were older, on average, although only slightly so, and PhD-qualified researchers were older, on average, than BSc- or MSc-qualified researchers—although at ISRA MSc-qualified researchers were older than their PhD-qualified colleagues on average, which is unusual (as is discussed further below). At ZARI, differences in the average age of researchers across the three degree levels were significant: in 2010, the average age of

researchers with BSc degrees at ZARI was 36 years, rising to 42 years for MSc-qualified researchers and 50 years for PhD-qualified researchers. During 2001–10, the average age of researchers increased from 44 to 50 years at ISRA and 42 to 45 years at KARI. No time-series data were available for the other three NARIs, although it is estimated that the average age of researchers is also likely to have increased, except at ZARI where relatively more younger researchers were hired in recent years.

Table 3. Average age of researchers by degree and gender, 2010

	Degree			Gender		
NARI	BSc	MSc	PhD	Male	Female	Total
ARC, South Africa	39.9	40.8	48.5	45.9	40.1	43.4
ISRA, Senegal	—	55.7	47.3	50.2	45.3	49.6
KARI, Kenya	41.6	45.1	49.5	45.5	44.2	45.1
ZARI, Zambia	36.4	42.0	50.0	40.0	38.7	39.7

Sources: Compiled by authors from underlying data of Liebenberg (2011), Mwala and Mwale (2011), Murithi and Minayo (2011), and Sène (2011).

An effective way of highlighting the distribution of researchers by age and gender is through an age pyramid (Figure 4). Such pyramids only allow the inclusion of two variables, so the distribution of researchers by degree level has been incorporated using bar graphs (Figure 5). Data by age and gender were also available for the support staff (see the Appendix).

Figure 4. Age pyramids of researchers by gender, 2010

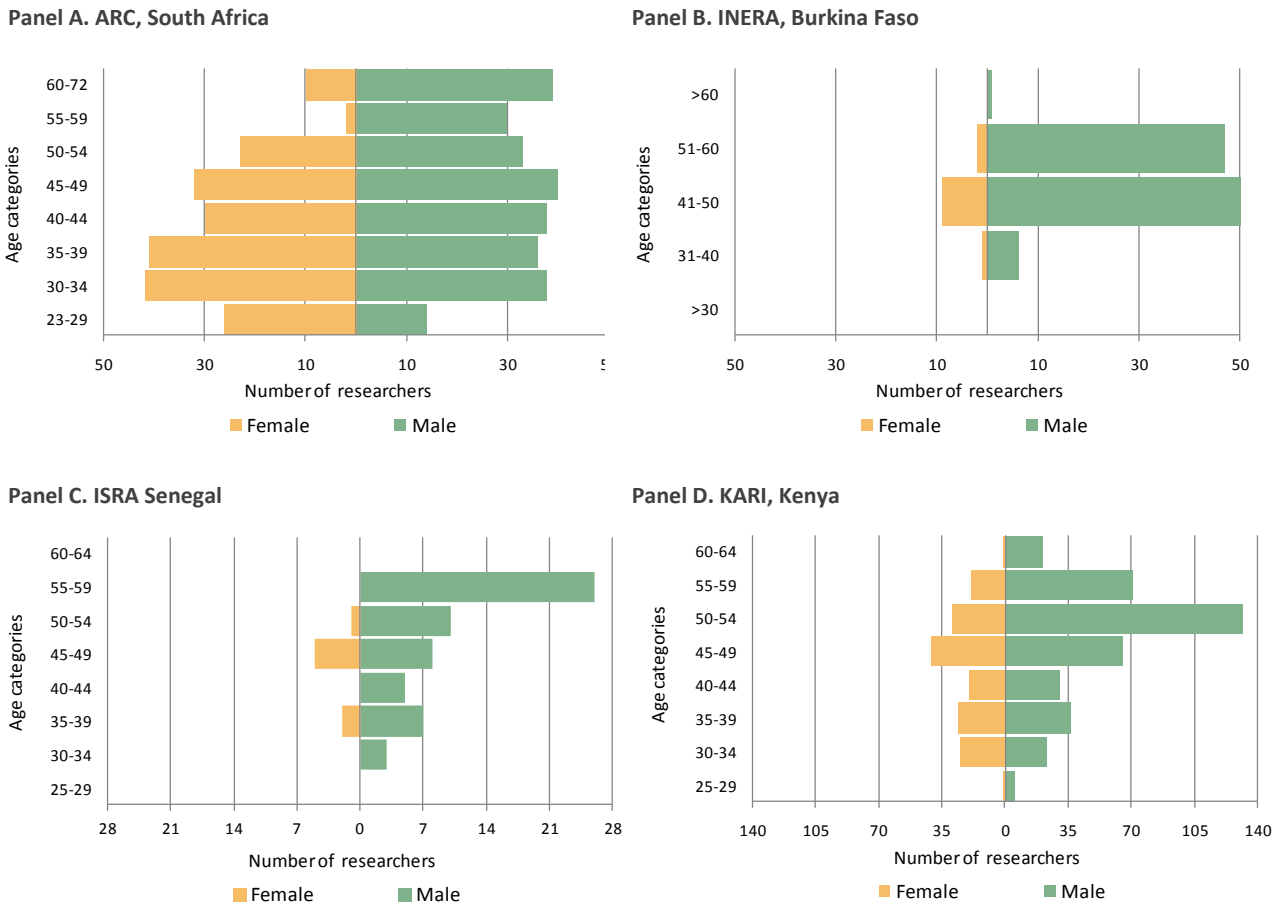
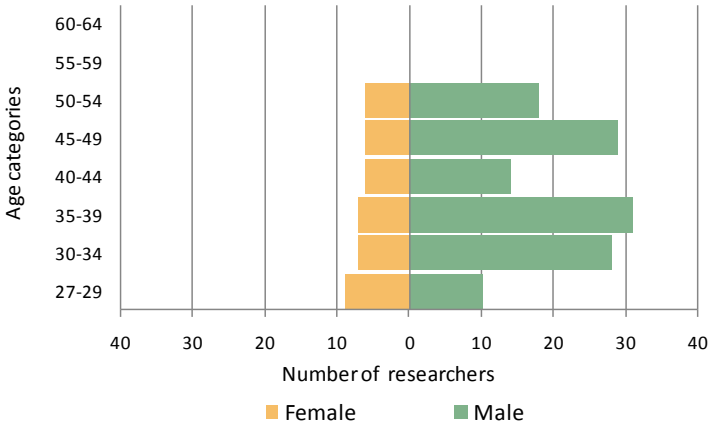


Figure 4. Continued

Panel E. ZARI, Zambia



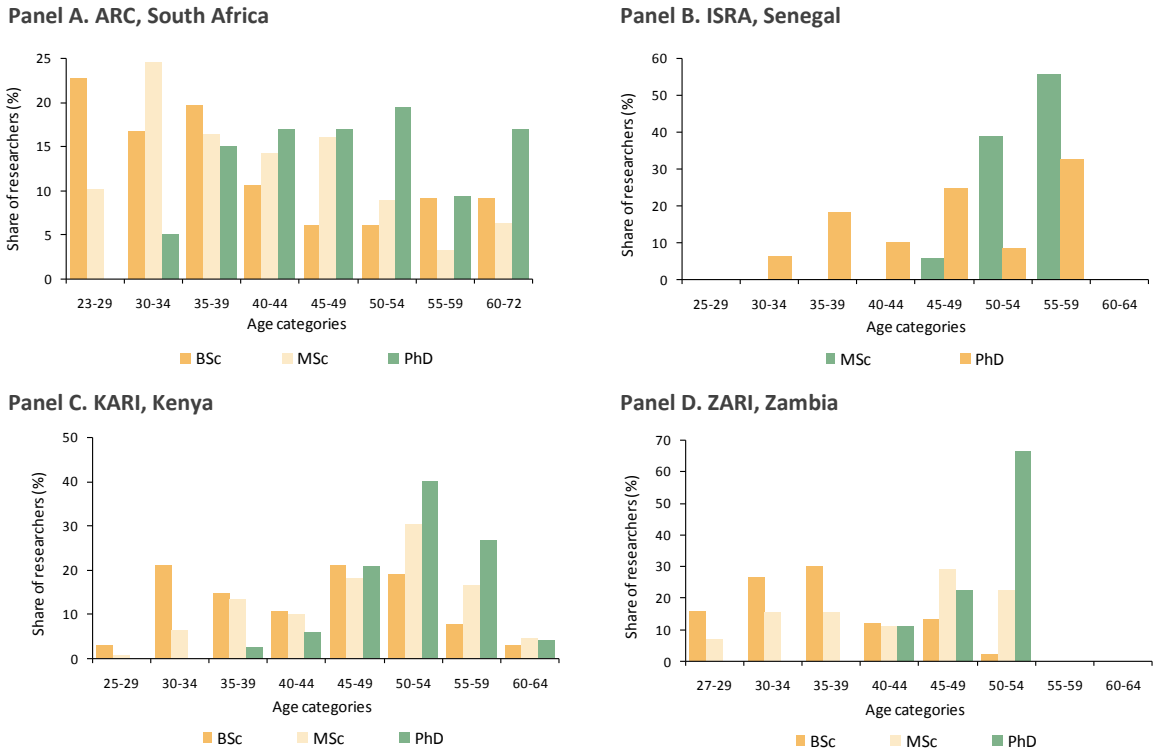
Sources: Compiled by authors from underlying data of Liebenberg (2011), Mwala and Mwale (2011), Murithi and Minayo (2011), and Sène (2011).
Note: Age data by gender were not available for INERA.

Distribution of Researchers by Age at the Agricultural Research Council, South Africa

The majority of female researchers employed at ARC in 2010 were in the lower age brackets, and the reverse was true for men (Figure 4, panel A). More than 60 percent of female researchers were younger than 40 years old compared with about 30 percent of the male researchers. In contrast 17 percent of the female researchers and 38 percent of the male researchers were 50 years or older. Although ARC's official retirement age is 65, in 2010 ARC employed six researchers who were older than 65 years, most of whom were retirees contracted to mentor younger researchers (Liebenberg 2011). A comparison of age pyramids for 2000 and 2010 (Liebenberg 2011) shows that the average age of ARC researchers increased over time: in 2000, 21 percent were over 50 years olds, whereas by 2010 this share had risen to 29 percent. The total number of scientists at ARC declined substantially between 2000 and 2003 in response to severe funding cuts and declining staff morale. Salary levels were frozen, and promotional opportunities were limited. This situation continued throughout the study period, coupled with organizational restructuring, which in turn led to further declines in researcher numbers (Table 4).

In 2010 researcher numbers at ARC were well distributed by age and qualification levels (Figure 5, Panel A). PhD-qualified researchers were almost equally distributed across the 35 to 72 year old age range at shares of between 15 and 20 percent, with the exception of researchers aged 55 to 59 years, of which only 9 percent held PhD degrees. Notably, many of the researchers who left ARC during 2000–03 were comparatively young and often only BSc-degree qualified, possibly reflecting lack of promotional opportunities, or greater opportunities in the higher education sector and elsewhere. The average age of staff who resigned in 2000, for example, was 40 years compared with 45 years in 2010. Nevertheless, BSc- and MSc-qualified staff still constituted the highest shares of staff departing ARC in 2010 (Liebenberg 2011).

Figure 5. Distribution of researchers by age and degree categories, 2010



Sources: Compiled by authors from underlying data of Liebenberg (2011), Mwala and Mwale (2011), Murithi and Minayo (2011), and Sène (2011).
Note: Age data by degree were not available for INERA.

Distribution of Researchers by Age at the Environment and Agricultural Research Institute, Burkina Faso

In 2010, about half of INERA researchers were at least 50 years old (Figure 4 Panel B). Although the official retirement age for researchers was raised from 63 to 65 years, as of 2010 all of the research directors and most of the senior researchers and research officers were due to retire within the next decade. Data on scientists by gender were not available for INERA at a similar level of detail as presented in Figure 5 for the other institutes.

Distribution of Researchers by Age at the Senegalese Agricultural Research Institute

As of 2010, close to 30 of ISRA's researchers representing about 40 percent of the Institute's research capacity, were due to retire by 2017. ISRA is advocating an increase in the official retirement age from 60 to 65 years, together with an improvement in the Institute's salary levels. Raising the retirement age, however, will only bring a temporary solution to ISRA's problem. As is common in most of the agencies, female researchers were generally younger (Figure 4, Panel C). In 2010, only 12 percent of the female researchers were 50 years or older (1 of 8 female researchers in absolute numbers) compared with more than 60 percent of the male researchers (36 of 59 male researchers in absolute numbers). To address the problem of ISRA's aging staff, the Senegalese government approved additional funding of US$1.6 million for 2012, which was supplemented by US$0.8 million from ISRA's own income. These funds will go toward hiring 10 new researchers, and an upward adjustment in researchers' salaries to achieve parity with those of the country's other researchers (Kouadio 2011).

PhD-qualified researchers are represented across all age categories from 30 to 59 years, but the highest share, at slightly more than 30 percent, is among researchers aged 55 to 59 years. As previously

mentioned, a surprising share of ISRA's MSc-qualified researchers are older. As of 1999, ISRA instituted a policy that all researchers required a PhD degree. Researchers with MSc degrees employed at ISRA at the time were offered the opportunity to pursue PhD training. ISRA's very high qualification requirements may promote staff turnover in the future and possibly discourage younger researchers from joining the Institute.

Distribution of Researchers by Age at the Kenya Agricultural Research Institute

KARI had serious difficulties maintaining a core of younger researchers because of a government recruitment freeze initiated in 1989. As a result, by 2010, 50 percent of the Institute's researchers were over 50 years old (46 percent were 50 to 59 years old and 4 percent were 60 years or older; Figure 4, Panel D). Only 22 percent of KARI's researchers were younger than 40 years old, presenting a serious succession problem. In 2004, KARI successfully lobbied the government to increase the retirement age for researchers from 55 to 65 years in efforts to address this problem (Flaherty et al. 2010). In 2010, 21 percent of the scientists, who otherwise would have had to retire, were 55 years or older, and 30 percent were aged between 50 and 54 years. KARI's age pyramid shows a more balanced, and hence favorable, distribution of female researchers compared with male researchers (more than half the men were between 50 and 59 years old, compared with only 30 percent of the women).

The distribution by degree and age clearly shows that KARI's aging problem is more severe at the higher degree levels (Figure 5, panel C). More than 70 percent of the PhD-qualified researchers were 50 years or older as of 2010, and close to half of these were scheduled for retirement by 2020. More than half the MSc-qualified researchers employed at KARI in 2010 were 50 years or older. The overall number of MSc- and PhD-qualified researchers employed at KARI increased during 2001–10 because researchers were encouraged to undertake higher degree training. Many researchers took advantage of opportunities offered by KARI through various donor-funded projects. The combination of this trend and the aforementioned recruitment freeze caused a significant decline in the number of BSc-qualified researchers employed at KARI. Most of the new BSc-qualified researchers were drawn from existing research support staff who undertook training in order to qualify for promotion (Murithi and Minayo 2011).

Distribution of Researchers by Age at the Zambia Agricultural Research Institute

The distribution of the ZARI's researchers across age groups is fairly even, particularly for female researchers (Figure 4, Panel E). However, because ZARI's official retirement age is only 55 years, more than a third of the Institute's researchers are due to retire by 2020. After the recruitment freeze was lifted in 2009, the number of researchers employed at ZARI grew substantially, but most were junior (BSc-qualified) researchers who also fell into the younger age brackets.

Although the absolute number of PhD-qualified researchers employed at ZARI increased from 6 in 2001 to 9 in 2010, two of these researchers are scheduled to retire in 2011, two will retire in 2012, and a further two will retire in 2015 (Figure 5, Panel D). As a result, ZARI's ratio of younger, less-qualified researchers to senior, well-qualified researchers—which is already high—will double by 2014 unless additional PhD-qualified researchers are recruited soon.

5. LOSS OF RESEARCHERS

Conditions at many NARIs are poor in terms of salaries, benefits, and retirement packages, as well as other incentives, such as the necessary infrastructure, operating budgets, collaborators, and management structures to successfully conduct research. As a result, many research agencies have difficulty retaining researchers, especially as they obtain higher degrees and are in a position to explore more attractive and more lucrative opportunities in the higher education and private sectors both within and beyond the

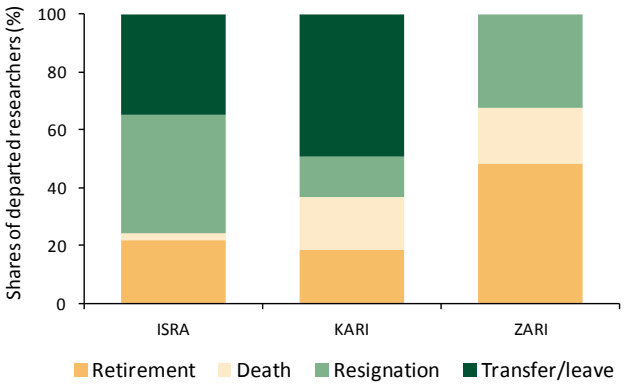
region (World Bank 2007; Beintema and Stads 2011). To varying degrees, these factors are also issues for the five NARIs under study. The aforementioned aging of researchers had a further negative impact on staff turnover at some of the NARIs, which is evident in Table 4 and Figures 6 and 7.

Table 4. Overview of researcher attrition, 2001–10

NARI	Departures	Year										10-year average
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
ARC, South Africa	Departed	185	191	162	138	25	65	66	159	207	80	128
	Total	620	578	539	517	492	534	527	520	501	474	530
	Turnover	**30%**	**33%**	**30%**	**27%**	**5%**	**12%**	**13%**	**31%**	**41%**	**17%**	**24%**
ISRA, Senegal	Departed	16	11	4	9	12	10	13	17	19	12	12
	Total	114	101	101	120	114	101	91	81	76	67	97
	Turnover	**14%**	**11%**	**4%**	**8%**	**11%**	**10%**	**14%**	**21%**	**25%**	**18%**	**13%**
KARI, Kenya	Departed	25	20	16	14	26	9	19	13	12	14	17
	Total	505	578	576	605	597	571	577	571	557	545	568
	Turnover	**5%**	**3%**	**3%**	**2%**	**4%**	**2%**	**3%**	**2%**	**2%**	**3%**	**3%**
ZARI, Zambia	Departed	7	7	4	5	7	7	5	4	4	6	6
	Total	117	120	118	103	105	102	128	160	174	171	130
	Turnover	**6%**	**6%**	**3%**	**5%**	**7%**	**7%**	**4%**	**3%**	**2%**	**4%**	**4%**

Sources: Compiled by authors from Liebenberg (2011); Mwala and Mwale (2011); Murithi and Minayo (2011); Sène (2011).
Notes: Data for INERA were not available.

Figure 6. Reasons for departure of researchers from ISRA, KARI, and ZARI, 2001–10 average



Sources: Compiled by authors from Mwala and Mwale (2011), Murithi and Minayo (2011), and Sène (2011).

Figure 7. Shares of researchers who retired or resigned from ISRA, KARI, and ZARI, 2001–10

Panel A. Shares of researcher that retired

Panel B. Shares of researchers that resigned

Sources: Compiled by authors from Mwala and Mwale (2011), Murithi and Minayo (2011), and Sène (2011).

Researcher Attrition at the Agricultural Research Council, South Africa

ARC reported extremely high and volatile turnover of its researchers for most of the 10-year period under study. The average rate of turnover was 24 percent—substantially higher than the averages recorded at the three other NARIs for which data were available. After a period of high resignations during 2000–04, ARC doubled its recruitment efforts, which lowered the turnover rate for a few years. After 2007 recruitment levels normalized, but the level of resignations remained high, so the turnover rate once again increased. Note also that, had temporary contracts been included in the calculation, the turnover rate would have been even higher.

Information on the reasons for departures was only available through annual report data on staff resignations based on exit interviews.[2] In the most recent report, 44 percent of all departing staff (not just researchers and scientists) resigned voluntarily. Of those, 38 percent indicated their reason for leaving to be salary levels and service conditions, 16 percent indicated working conditions and organizational culture, and a significant 29 percent chose not to provide a reason.

Researcher Attrition at the Environment and Agricultural Research Institute, Burkina Faso

Specific data on staff departures from INERA were not available, other than through the survey conducted as part of the case study. Excluding losses due to death or retirement, close to half the former researchers departed to take up positions in regional or international organizations or in other departments or ministries. About 20 percent of the departing senior researchers, for example, were appointed to senior management positions in ministerial departments during 2005–10, and many of the agricultural engineers left for better opportunities in the private sector. The reasons provided by former researchers for leaving INERA were low salary levels, inadequate equipment and facilities, and lack of individual recognition.

The government of Burkina Faso took measures to improve the salary levels of its researchers, and a new salary and benefit package was adopted in 2009. Nonetheless, salaries remain low compared with those offered by nongovernmental agencies, so staff departures have continued.

Researcher Attrition at the Senegalese Agricultural Research Institute

The average rate of turnover of researchers at ISRA was 13 percent during 2001–10, but it fluctuated substantially from year to year. The rate fell from 14 percent in 2001 to 4 percent in 2003, then increased to 25 percent in 2009 due to low recruitment levels combined with a high number of retirements and resignations, or temporary reassignments to ministries or international organizations. Although the aging of ISRA's researchers is a concern for the future, the relatively high level of resignations is an even more serious issue. During 2001–10, in addition to the retirement of 22 researchers, an additional 41 researchers resigned. This exodus was particularly severe during 2007–09, during which time about 8 percent of all ISRA's researchers resigned per year (Figure 7). Almost all of these researchers were interviewed for the country case study, indicating that low salary levels and poor service conditions were their main reasons for leaving. In an attempt to halt this exodus, ISRA instituted a set of new rules and regulations in efforts to improve researchers' working conditions.

Female researchers represent only 15 percent of the researchers who resigned (less than the share of female researchers employed), which is consistent with the trend in various African countries (Beintema and Di Marcantonio 2010).

[2] Exit interviews are conducted by the resigning staff member's supervisor, or with the head of Human Resources if requested, which may influence the responses given.

Researcher Attrition at the Kenya Agricultural Research Institute

KARI recorded the lowest and most constant average rate of turnover of researchers over the 10-year study period, at 3 percent, stemming both from low departure levels, in part due to an increase in the official retirement age, and from low recruitment levels, largely based on a hiring freeze. About half of the 168 researchers that did leave KARI during 2001–10 were transferred to other government departments, were dismissed, or took a leave of absence (often to pursue higher education at American or European universities); 18 percent of these researchers retired, 18 percent died, and 14 percent resigned. Overall the share of researchers that either retired or resigned was less than 1 percent of all researchers employed at KARI during the period, on average. Of the researchers who resigned, some accepted positions at local universities with similar salary packages but more flexible working environments, and some secured positions at regional or nongovernmental organizations (NGOs), or in the private sector, or at centers of the Consultative Group on International Agricultural Research (CGIAR). Given that more than half of KARI's researchers were 50 years or older as of 2010, losses to retirement will rise in the coming years.

Researcher Attrition at the Zambia Agricultural Research Institute

Although ZARI had a relatively low average rate of turnover of researchers, at 4 percent on average during 2001–10, the rate fluctuated substantially and was particularly high during the early 2000s due to a recruitment ban. 48 percent of the departed researchers retired, 32 percent resigned, and 19 percent died. Many of the researchers that resigned from ZARI were dissatisfied with the Institute's remuneration and employment conditions.

6. RESEARCHER RETENTION

Many agricultural R&D agencies in Africa are seriously challenged when it comes to retaining well-qualified staff, as was illustrated in the previous section. Various studies have identified that lack of job satisfaction and motivation are key factors, in addition to low salaries and lack of additional benefits, such as health insurance. In exploring staff motivation, Maslow (1943) developed a hierarchy of needs that included physiological, safety, social, ego-gratifying, and self-actualizing needs. If decisionmakers within NARIs are to succeed in improving staff motivation and retention, awareness of human resource management practices is a must (Table 5).

Results of a survey of 40 researchers currently employed at ZARI clearly indicated that their motivation would increase if conditions of service were to improve. High on the list of factors was assistance with or provision of loans and provision of training. Neither salary levels nor improved research equipment were not cited as major motivating factors. KARI commissioned a 2009 survey to assess employee satisfaction levels; of nearly 500 staff members interviewed, 80 percent indicated that they were satisfied. The need for incremental increases in remuneration and allowances was cited by almost a quarter of the staff members interviewed. Promotion by merit, equal opportunities for training, and more research facilities were also rated as important areas needing improvement. Of staff departing ARC voluntarily, the largest share indicated that their reason for leaving was the pursuit of improved salary and service conditions, followed by dissatisfaction with the existing work environment and organizational culture. A survey of departing staff at INERA revealed that the lack of training opportunities, including scholarships, was most important factor driving departures, followed by limited career advancement, low wages and allowances, and poor working conditions. At ISRA, the most prevalent reason staff gave for leaving was the lack of a clear career path, especially for researchers, followed by the low salaries and other benefits, a poor work environment, and general work frustration. A small percentage of departing staff also cited lack of government recognition of the importance of R&D as a factor in their decision (Table 6).

Table 5. Examples of critical factors affecting and causes of staff turnover and retention

Critical factors drawn from motivation theory	Causes of high staff turnover in the absence of retention strategies
Employee needs are based on individual, family, and cultural values, and on their current and desired economic, political, and social status; career goals; and work–life balance, among other factors	• The benefits offered do not meet needs across all the employee categories • The organization does not allow or promote flexible work schedules • No attention is given to the employees' need to balance work, family, and education
Employees prefer to work within a productive, respectful, and friendly environment	• Managers are not functioning as coaches and facilitators
Employees may need additional responsibilities for which they are appropriately rewarded in order to feel competent and be motivated to perform in a more challenging capacity	• Pay rates are not based on performance • Employees do not know what skills are needed in order to advance professionally and to reap the rewards of improved performance
Employees want to be rewarded fairly, regardless of age, gender, ethnicity, and so on; higher performance should be rewarded	• Promotions are not based on performance • Recruitment efforts need to target women, diverse ethnicities, and broad geographical and economic demographics
Employees prefer to perform in a challenging work environment that provide opportunities for personal development and to learn, advance, and contribute to the organization's success	• Lack of a systemic approach to training and development • Training and development efforts are not part of assessments • Lack of commitment to the long-term development of employees • Career planning and development efforts are not tied to the organization's business objectives
Employees need to have timely and open feedback from their supervisors both in an ongoing, informal way and through a formal process of performance appraisal	• Manager perceived as being unfair • Lack of a formal appraisal process

Source: Adapted from Lamlall (2004).

Table 6. Areas evoking dissatisfaction or needing improvement as cited by researchers

NARI/survey details	Main areas cited as evoking dissatisfaction or needing improvement
ARC, South Africa HR survey of voluntary departing researchers	• Poor salary levels/service conditions (38%) • Poor work environment/organizational culture (16%) • No clear reason given (29%)
INERA, Burkina Faso Survey of 67 employed researchers	• Lack of scholarships and other training opportunities • Lack of career advancement opportunities • Low wages and allowances • Poor working conditions, including limited research budget and equipment
ISRA, Senegal Survey of 67 employed researchers and 29 former researchers who had recently resigned	• Lack of a clearly defined career path, especially for researchers (45 %) • Poor salary/service conditions (31 %) • Poor work environment (13%) • Lack of equity in allocating rewards following performance evaluation (frustration) (10%) • Lack of government recognition of ISRA's role in economic development (1%)
KARI, Kenya External survey of 498 staff conducted in 2009	• Need for incremental increases in remuneration and allowances (23%) • Inequity in promotions, which should be based on merit (13%) • Lack of equal opportunities for training, especially at lower levels (11%) • Need for more research facilities (8%)
ZARI, Zambia Survey of researchers conducted in 2011	• Lack of facilitation or provision of personal loans (35%. • Lack of provision of training (24%) • Lack of provision of accommodation, promotional opportunities, improved salary levels, insurance (6% to 10% each)

Sources: Compiled by authors from Liebenberg (2011); Kaboré, Ouédraogo, and San (2011); Mwala and Mwale (2011); Murithi and Minayo (2011); and Sène (2011).

Remuneration Packages

Low salary and benefit levels make it difficult for many NARIs to compete with the private sector, NGOs, and international organizations in recruiting and retaining well-qualified staff. This was the main reason cited for staff departures from INERA and ISRA. The surveys conducted revealed that researchers who had left INERA and ISRA for other positions were being paid three to five times more in their new positions. In some countries, universities are also able to offer higher salary packages, although this was not the case in either Kenya or South Africa. KARI and ARC offer similar salary and benefit packages to Kenyan and South African universities, respectively. Despite this, university positions are often perceived as being more attractive because they offer increased freedom in terms of working hours (which tend to be rigid at NARIs), the potential to earn additional income through consultancies, opportunities to collaborate with other researchers and institutions, and the ability to take sabbatical and other kinds of leave. In addition, salary levels at ISRA and ZARI are much lower than those offered at the universities.

Salary packages are important, but this includes maintaining their competitiveness over time. Salary levels at ARC, for example, were not regularly increased over the study period and did not kept pace with levels offered elsewhere or with inflation. In addition, adjustments in subsistence and travel allowances often fell short of rates offered elsewhere in the public service. This reality may present the most compelling explanation for the sharp rise in the rate of resignations coinciding with each phase of restructuring at ARC.

Training Policies

The provision of both short- and long-term training presents a key opportunity for NARIs to improve and update human resource capacity, while at the same time motivating and rewarding staff. INERA's first training plan was created in 1999 and focused on long-term training (two to five years) financed through external sources. ISRA also developed its first training plan in the early 1990s to address the future loss of researchers through retirement. ISRA followed the plan's recommendation that it establish a training unit. Since 1997 the Institute has followed a policy of on the job training ("training by doing"). In addition, it has offered select Senegalese students undertaking the equivalent of BSc training the opportunity to conduct their thesis work at ISRA under the supervision of a senior scientist, with the added benefits of a training grant and a research position when they attain their degrees. Funding for these scholarships is often provided by the government and more recently through West African Agricultural Productivity Program (WAAPP). In 2011, 10 students were selected for this grant, including three women.

INERA and ISRA's participation in WAAPP should significantly contribute to the reinforcement of research capacity at both NARIs. A major objective of WAAPP is to improve the efficiency and performance of agricultural R&D by strengthening the NARIs' technical, administrative, and financial management capacity. The program includes training for young scientists through exchange programs with regional and international organizations.

KARI has probably one of the most well-established training programs of the African NARIs (Box 1). The Institute recently carried out a training needs assessment, which resulted in a coordinated master plan that has raised staff morale because they were consulted throughout the process. Current initiative, including the World Bank–supported East African Agricultural Productivity Project (EAAPP) and the Kenya Agricultural Productivity and Agribusiness Project (KAPAP), are supporting KARI's researchers in improving their qualifications and skills. Staff receive paid study leave while undertaking training on the basis that they commit to return to the Institute upon completing the training for a specified (minimum) period of time. ZARI's training policy is implemented through the Public Service Training and Development Policy, which articulates institutional implementation arrangements. Training is funded through budgetary allocations, supplemented by contributions from cooperating partners. A key

constraint to training efforts in recent years has been both low and erratic levels of funding, which is a common problem in many countries in the region.

Increased training opportunities also have a potential downside for NARIs in that increased training is generally associated with increased specialization, which can limit staff mobility across disciplines, and thereby also limit opportunities for advancement. In addition, more highly qualified and experienced researchers become more attractive to other agencies, which, as previously discussed, are often in a position to offer better salaries, benefits, and conditions.

In addition to formal training, other opportunities for learning and advancement within organizations can have a positive impact on staff morale and motivation. Such opportunities include the mentoring of younger, less well-educated research by senior researchers, as well as opportunities for collaboration with regional and international agencies and the private sector, which has also been shown to increase opportunities for publishing the results of research in internationally recognized reports, journals, and books.

Performance Appraisals Processes and Reward Systems

Formal assessment of staff performance is crucial for any organization, and all NARIs reported having a performance appraisal system in place. To be efficient, a performance evaluation system should be (1) simple, practical, specific, relevant, and nontrivial (that is, it should exclude petty or unimportant issues); (2) fair, consistent, and competently undertaken at regular intervals; (3) undertaken with transparency, through consensus, and with the sanction of the organization's headquarters; and (4) tied to the organization's system of remuneration. Unless these requirements are met, performance appraisals will cause frustration and dissatisfaction. ARC, for example, had a performance appraisal process that was terminated in 2003, leaving staff without a formal means of pursuing promotions, which led to dissatisfaction and presumably staff departures. At ZARI, staff undergo an annual evaluation, but any ensuing rewards are minor. Staff at INERA are also evaluated annually and according to civil service regulations. The aforementioned country-level assessment was carried out most intensively in 2008 and 2009. Prior to 2008 assessments were based on a simple report from human resources, which led to an automatic promotion every two years. The effect of the appraisal process is almost exclusively financial because it applies to all civil servants and doesn't include any recognition of scientific outputs, which has led to frustration among researchers. ISRA has conducted performance evaluations three times in the past 20 years (in 1993, 2005, and 2010). ISRA has now integrated a subregional performance appraisal system; assessments resulted in both promotions and salary increases.

The first performance evaluation of researchers at KARI was completed in 2000/01, and researchers who met the minimum required scores were promoted a grade. Thereafter, KARI's senior management requested that the government raise salary levels, which was approved in 2004. Staff were promoted to the next-highest ranking within their grade (their grades/job titles remained unchanged). In 2008, researchers were once again evaluated and promoted based on the minimum required scores. This process has now been institutionalized and will be conducted every three years, providing strong motivation for staff to perform at their best. In addition—given the value of degree training—promotion is still possible through the attainment of higher degree qualifications. KARI's performance evaluation system, as well as various other measurements the Institute institutionalized could serve as an example for other NARIs in Africa (Box 1). The system clearly illustrates the need for, and value of, strong government support.

Box 1. Incentives to improve staff motivation and retention: KARI as a model for other NARIs

Recognizing the challenge of retaining well-qualified staff, KARI institutionalized a variety of incentive measures over time to address this challenge.

- In 1980s, the staff of the former Scientific Research Division of the Ministry of Agriculture and Livestock was consolidated under KARI, which ensured the management of nearly half the country's agricultural research researchers. This single entity provided uniform terms and conditions of employment. The Institute has continued to provide opportunities for researchers and technicians to advance their skills by providing government- and donor-supported scholarships and study leave, enabling staff to attain higher degrees, thereby becoming eligible for promotion. KARI's performance-based staff evaluation process has been institutionalized to improve opportunities for promotion and increased remuneration.
- KARI succeeded in lobbying the government to raise the official retirement age, which ameliorated the Institute's succession problem in the short term.
- KARI also succeeded in lobbying the government to increase staff salary and allowance levels, providing incentives in terms of general morale/motivation, the quality of work output, and the decision to remain in employment with KARI as opposed to leaving. In terms of working conditions, researchers are being encouraged to accept part-time teaching position at nearby universities and to engage in research consultancies, provided that these arrangements are officially communicated to KARI's management.
- In 2008, the Institute completed the development of comprehensive human resource documentation (terms and conditions of service, and so on), superseding the use of more generic, central government policies. This significantly improved staff morale by ensuring consistent, transparent, and predicable processes that previously had been considered ad hoc.
- In 2010, the Institute carried out a training needs assessment in which staff actively participated. The exercise contributed to the establishment of a master training plan that has raised staff morale. Staff undertaking training are provided with paid study leave and are "bonded" to the Institute upon completing their training for a fixed (minimum) period of time.
- KARI staff also have the opportunity to take a leave of absence to undertake short-term work with other institutions that conduct research of relevance to KARI.
- Comprehensive group insurance is now provided in the event that staff are involved in an accident while at work, and comprehensive medical insurance for all staff also came into effect as of October 2011.

Source: Developed by authors based on Murithi and Minayo (2011).

7. CONCLUSION AND RECOMMENDATIONS

Further findings and specific recommendations for each of the countries are outlined below in Tables 7 and 8.

Table 7. Summary of key findings by country

Topic	ARC, South Africa	INERA, Burkina Faso	ISRA, Senegal	KARI, Kenya	ZARI, Zambia
Gender equity	The share of female researchers is one of the highest in SSA (43 percent in 2010), but comparatively more women fall into the lower age groups	Despite growth since 2001, the share of female researchers remains low (13 percent in 2010)	Despite growth since 2001, the share of female researchers (remains slightly lower than the SSA average (21 percent in 2010); many researchers fall into the older age groups	The share of female researchers is comparatively high (30 percent in 2010) and shares are balanced across all age groups	The share of female researchers is slightly higher than the SSA average (25 percent in 2010)
Age distribution	The age distribution is reasonable, but the average age is increasing because comparatively more young researchers have departed	About half of the researchers were at least 50 years old as of 2011; as a result, most senior staff are scheduled to retire by 2020	Close to 30 percent of researchers are scheduled to retire by 2017	More than half of all researchers are over 50 years old, and the aging problem is more severe at higher degree levels	Age distribution is fairly even, but one-third of researchers are scheduled to retire by 2020; most new recruits are young and inexperienced
Retirement age	Good (65 years)	Good (65 years)	Low (60 years)	Good (65 years)	Very low (55 years)
Attrition	The turnover rate is very high and volatile, averaging 25 percent during 2001–10	Information was not available	The turnover rate is high and volatile, averaging 14 percent during 2001–10	The turnover rate is low and constant, averaging 3 percent during 2001–10	The turnover rate is low, but volatile, averaging 3 percent during 2001–10
Recruitment	Recruitment efforts were high during 2005–06 as a result of earlier high number of resignations	Information was not available	Recruitment efforts have been low	A recruitment freeze is still in place	Recruitment efforts increased substantially when the freeze was lifted in 2007
Remuneration	Salary and benefit packages are on par with the university sector	A new salary and benefit package was adopted in 2009, but salaries remain low compared with nongovernmental agencies	Salary and benefit packages are low, which has been cited as the main reason for staff departures	Salary and benefit packages are on par with the university sector	Salary and benefit packages are low, which has been cited as the main reason for staff departures
Performance appraisal and reward	The former performance appraisal process was terminated in 2003	Annual increases are awarded according to civil service regulations	Performance appraisals were on conducted in 1993, 2005, 2010	An effective system is in place that can serve as an example for other countries	Annual evaluations are conducted, but ensuing awards are minor
Training	Information was not available	The first training plan was instituted in the early 1990s; current policy is on the job training, but this will be expanded through WAAPP	The first training plan was instituted in the early 1990s; current policy is on the job training, but this will be expanded through WAAPP	An effective system is in place that can serve as an example for other countries	Plans follow the Public Service Training and Development Policy

Sources: Developed by authors based on Liebenberg (2011); Mwala and Mwale (2011); Murithi and Minayo (2011); Sawadogo, Ouédraogo, and San (2011); and Sène (2011).

Table 8. Country-specific recommendations

Topic	ARC, South Africa	INERA, Burkina Faso	ISRA, Senegal	KARI, Kenya	ZARI, Zambia
Gender equity	Maintain gender balance within current range	Raise the share of women from 12 to 20 percent by 2020	Raise the share of women from 20 to 40 percent by 2020	Raise the share of women from 30 to 40 percent by 2020	Raise the share of women from 19 to 29 percent by 2020
Age distribution	Improve career path for researchers, particularly to reduce attrition among those with 11–15 years of experience	Lower the average age of researchers from 55 to 40 years by 2020	Lower the average age of researchers from 50 to 40 years by 2020	Lower the average age of researchers from 45 to 40 years by 2020	Maintain the current average age of researchers at approximately 39 years by 2020
Retirement age	Maintain the current age of retirement 65 years	Maintain the current age, which was raised to 65 years in 2010	Raise the retirement age from 60 to 65 years by 2012	Maintain the current age of retirement 65 years	Raise the retirement age from 55 to 65 years by 2013
Attrition	Reduce the average 2001–10 rate of turnover among researchers from 17 to 8 percent by 2015	Undetermined based on lack of available information	Reduce the average 2001–10 rate of turnover among researchers from 18 to 8 percent by 2015	Maintain the current average 2001–10 rate of turnover among researchers at 3 percent or lower	Maintain the current average 2001–10 rate of turnover among researchers at 4 percent or lower
Recruitment	Increase recruitment of PhD-qualified researchers	Increase recruitment of PhD-qualified researchers	Establish a 10-year recruitment plan targeting 10 researchers per year	Recruit a sufficient number young PhD-qualified researchers	Increase recruitment of PhD-qualified researchers
Remuneration	Sensitize government to need to increase ARC salaries to curtail the loss of researchers	Increase salaries so they are competitive with NGOs	Approval of new ISRA rules and regulations by government	Develop a more competitive remuneration package to curtail the loss of researchers	
Performance appraisal and reward	Reinstitute a performance appraisal process incorporating an effective reward system	Initiate an internal performance evaluation system adapted to local research demand	Reward the best researchers based on results of performance appraisal	Maintain the current, effective system, which should be used as an example for other countries	Establish a performance appraisal system (for example, emulating KARI's system)
Training	Existing training program for young researchers is efficient	Establish a training plan based on a needs analysis	Improve the process by sensitizing research managers	Maintain current efficient system, which should be used as an example for other countries	Decouple ZARI's training plan from that of the overall public service

Source: Developed by authors based on Liebenberg (2011); Mwala and Mwale (2011); Murithi and Minayo (2011); Sawadogo, Ouédraogo, and San (2011); and Sène (2011).

The five case studies underlying this paper highlighted a large number of human resource challenges that NARIs need to address. The following general recommendations are put forward in hopes of facilitating this process.

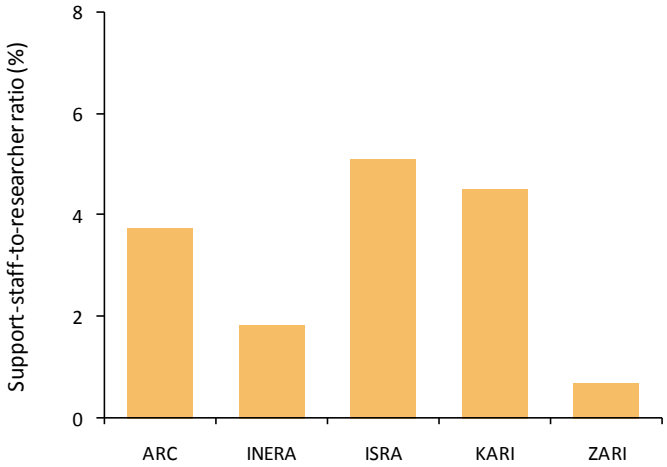
- The retirement age should be increased to 65 years for all countries, although it is noted that this action only serves as a temporary solution to the succession problem; detailed training and succession plans are needed to guide the implementation of strategies to address this problem long term. Any remaining recruitment freezes would need to be lifted, even if only partially.

- Career paths for researchers need to be improved; this is particularly important for reducing attrition among those who have been in service for between 11 and 15 years so as to minimize the age gap between newly recruited young researchers and those nearing retirement.
- Governments need to be sensitized to the importance of competitive remuneration packages to curtail further losses of researchers; salary levels should at least be on par with the university sector and be adjusted based on national inflation rates.
- Working conditions need to be improved in terms of infrastructure enhancements, operating budgets, and organizational cultures.
- Performance appraisal processes that generate an effective award system need to be instituted; KARI's system could serve as a model for other countries.
- The training of young researchers needs to be accelerated through the establishment of training plans, which includes a system of mentoring young staff by senior and, perhaps, even retired researchers. Once again, KARI's training system could be used an example for other countries; ARC's mentoring system—which involves the hiring of retired researchers—is also exemplary.
- The type of analysis conducted in the five case studies might be extended to other SSA countries and be fed into a position paper on strategies for rationalizing human resource capacity.

APPENDIX. SUPPORT STAFF

The desirable composition of research staff within research institutes in SSA is often the subject of discussion and sometimes of controversy. Finding a balance in the ratio of support staff to researchers is one concern, and one that heavily depends on the type of research being conducted, as well as specific agency classifications of staff based on their degree qualifications (for example, at some agencies support staff may not be highly trained, whereas at other agencies they might be trained to the BSc, MSc, or in some cases even the PhD level. ARC, ISRA, and KARI have similar support-staff-to-researcher ratios of around 4 to 5 (Figure A1). The corresponding ratios at ZARI and INERA are only around 1, so it can generally be stated that it would be advisable for these agencies to increase their ratios to achieve better and more efficient balance. More specific recommendations need to be made with caution, taking into account the relevant circumstances of each country and agency, the type of research being conducted, the research needs being addressed, the size of the national agricultural system, and so on.

Figure A1. Support-staff-per-researcher ratios, 2010



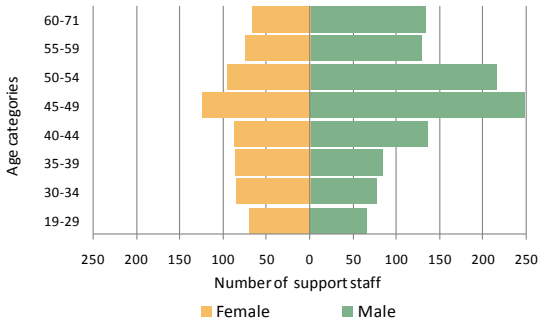
Sources: Compiled by authors from Liebenberg (2011); Kaboré, Ouédraogo, and San (2011); Mwala and Mwale (2011); Murithi and Minayo (2011); and Sène (2011).

Notes: Support staff includes technicians, research assistants, administrative staff, laborers, and so on, but each NARI has its own specific classifications, which complicates cross-country and cross-agency comparisons.

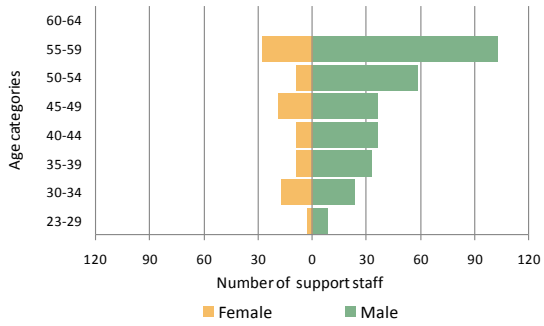
Data by age and gender were also available for support staff (Figure A2). The resulting pyramids show a slightly more balanced distribution across age and gender compared with those for researchers. The pyramids also show that ISRA's and KARI's challenge of an aging pool of researchers extends to the Institute's support staff. For example, 44 percent of KARI's support staff were 50 years or older in 2010 compared with 50 percent of researchers that same year. At ISRA, 55 percent of support staff fell into this age category in 2010. Notably, the issue of aging support staff at ISRA is substantially more severe than is the aging of researchers: 40 percent of ISRA's support staff were 50 years or older in 2010 compared with 29 percent of the Institute's researchers.

Figure A2. Age pyramids of support staff by gender, 2010

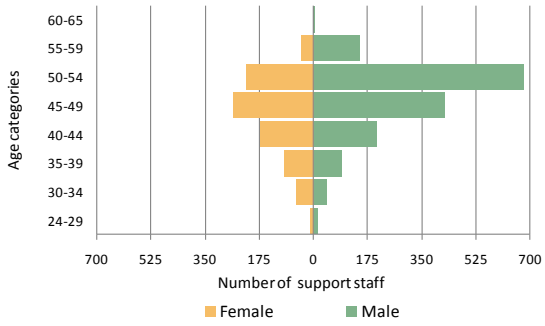
Panel A. ARC



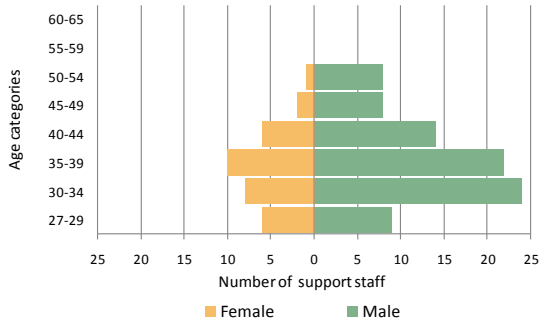
Panel B. ISRA



Panel C. KARI



Panel D. ZARI



Sources: Compiled by authors from underlying data of Liebenberg (2011), Mwala and Mwale (2011), Muritihi and Minayo (2011), Sène (2011).

REFERENCES

Ackers, L. 2004. Managing Relationships in Peripatetic Careers: Scientific Mobility in the European Union. *Women's Studies International Forum* 27 (3): 189–201

Beintema, N. M., and G. J. Stads. 2011. *African Agricultural R&D in the New Millennium: Progress for Some, Challenges for Many*. IFPRI Food Policy Report. Washington, DC: International Food Policy Research Institute.

Beintema, N. M., and F. Di Marcantonio. 2010. *Female Participation in African Agricultural Research and Higher Education: New Insights. Synthesis of the ASTI–Award Benchmarking Survey on Gender-Disaggregated Capacity Indicators*. IFPRI Discussion Paper 957. Washington, DC, and Nairobi: International Food Policy Research Institute and African Women in Agricultural Research and Development.

Beintema, N. M., and M. Rahija. 2011. *Human Resource Allocations in African Agricultural Research: Revealing More of the Story behind the Regional Trends*. Paper prepared for the ASTI/IFPRI–FARA conference, "Agricultural R&D: Investing in Africa's Future: Trends, Challenges, and Opportunities." Conference Working Paper 12. Washington, DC, and Accra: International Food Policy Research Institute and Forum for Agricultural Research in Africa.

Flaherty, K., F. Murithi, W. Mulinge, and E. Njuguna. 2010. *Kenya*. ASTI Country Note. Washington, DC, and Nairobi: International Food Policy Research Institute and Kenya Agricultural Research Institute.

Kaboré, S. S., I. Ouédraogo, and T. San. 2011. Staff Aging and Turnover in National Agricultural Research Institutes: A Case Study on Burkina Faso's Environment and Agricultural Research Institute. Agricultural Science and Technology Indicators (ASTI) initiative, International Food Policy Research Institute, Washington, DC.

Kouadio, T. 2011. Senegal to Search for Younger Agricultural Researchers. SciDev Net. December 14. <http://www.scidev.net/en/science-and-innovation-policy/r-d-in-africa/news/senegal-to-search-for-younger-agricultural-researchers.html>.

Lamlall. S. 2004. A Review of Employee Motivation Theories and their Implications for Employee Retention within Organizations. *Journal of American Academic of Business* 5 (1/2): 52–63.

Liebenberg, F. 2011. The Challenge of An Aging Pool of Agricultural Research Staff: A Case Study on South Africa's Agricultural Research Council and the Faculty of Agricultural and Natural Resources of the University of Pretoria. Agricultural Science and Technology Indicators (ASTI) initiative, International Food Policy Research Institute, Washington, DC.

Lindner, J. R. 1998. Understanding Employee Motivation. *Journal of Extension* 36 (3).

Maslow, A. H. 1943. A Theory of Human Motivation. *Psychological Review* 50: 394–395.

Mwala, M. S., and M. Mwale. 2011. Staff Aging and Turnover in National Agricultural Research Institutes: A Case Study on Zambia Agricultural Research Institute. Agricultural Science and Technology Indicators (ASTI) initiative, International Food Policy Research Institute, Washington, DC.

Murithi, F., and C. Minayo. 2011. Staff Aging and Turnover in National Agricultural Research Institutes: A Case Study on the Kenya Agricultural Research Institute. Agricultural Science and Technology Indicators (ASTI) initiative, International Food Policy Research Institute, Washington, DC.

Sène, L. 2011. Staff Aging and Turnover in National Agricultural Research Institutes: A Case Study of the Senegalese Agricultural Research Institute. Agricultural Science and Technology Indicators (ASTI) initiative, International Food Policy Research Institute, Washington, DC.

Stads, G. J., and S. S. Kaboré. 2010. *Burkina Faso*. ASTI Country Note. Washington, DC, and Ouagadougou: International Food Policy Research Institute and Institut de l'environnement et de recherches agricoles.

Stads, G. J. and L. Sène. 2010. *Senegal*. ASTI Country Note. Washington, DC, and Dakar: International Food Policy Research Institute and Institut sénégalais de recherche agricole.

World Bank. 2000. *Can Africa Claim the 21st Century?* Washington, DC.

_____. 2007. *World Development Report 2008: Agriculture for Development.* Washington, DC.

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The Agricultural Science and Technology Indicators (ASTI) initiative compiles, analyzes, and publishes data on levels and trends in agricultural R&D investments, capacities, and institutional arrangements in developing countries. ASTI is managed by the International Food Policy Research Institute (IFPRI) and involves collaborative alliances with many national and regional R&D agencies.

Jointly convened by ASTI/IFPRI and the Forum for Agricultural Research in Africa (FARA), the conference, "Agricultural R&D—Investing in Africa's Future: Analyzing Trends, Challenges, and Opportunities," brought together experts and stakeholders from the region to contribute their expertise for the purpose of distilling new insights and creating synergies to expand the current knowledge base. The themes under focus were (1) why African governments under invest in agricultural R&D; (2) how human resource capacity in agricultural R&D can be developed and sustained; (3) how institutional structures can be aligned and rationalized to support agricultural R&D; and (4) how the effectiveness of agricultural R&D systems can be measured and improved.

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