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**EDUCATING AGRICULTURAL RESEARCHERS:
A REVIEW OF THE ROLE OF AFRICAN UNIVERSITIES**

Nienke M. Beintema, Philip G. Pardey, and Johannes Roseboom

Environment and Production Technology Division

**International Food Policy Research Institute
2033 K Street, N.W.
Washington, D.C. 20006 U.S.A.**

and

**International Service for National Agricultural Research
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ABSTRACT

The number of higher-education institutions and the students enrolled in them has grown rapidly throughout Africa since the early 1960s. The number of universities increased from less than 20 in 1960 to nearly 160 by 1996; student numbers grew from 119,000 to almost two million over the same period, yet enrollment ratios in Africa continue to lag well behind developed and other-developing country norms. Funding for higher-education in Africa kept pace with the expanding institutional base during the 1960s and 1970s, but has fallen well behind the growth in student numbers since 1980. The pattern of the development of the agricultural sciences has matched the general pattern of development of the higher-education sector.

Three quarters of the countries in Africa currently offer some tertiary training in the agricultural sciences. Only one half of the African faculties of agricultural sciences offer postgraduate degrees, and most of these programs were established in the past decade. Nonetheless, much of the rapid growth in the number of national scientists working in national agricultural research institutes continues to rely on scientists trained to the postgraduate (and also BSc) level outside the region.

Key words: university education, Africa, agriculture, R&D, human capital

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Nienke M. Beintema, Philip G. Pardey, and Johannes Roseboom*

1. INTRODUCTION

Agricultural research, like research more generally, is a knowledge-intensive activity. A viable national research effort requires a ready supply of scientists and technical support staff with the right training and skills. Universities have training and research roles, and both are clearly related. The past and present research roles of the higher-education sectors, and, more specifically, sub-Saharan African (hereafter to referred as African) universities have been the topic of some prior work.¹ Here we highlight the training aspects of universities, and the consequences this training has on the supply of human capital required to carry out research in future generations. The public

* Nienke Beintema is a research analyst and Philip Pardey a research fellow at the International Food Policy Research Institute in Washington, D.C. Johannes Roseboom is a research officer at the International Service for National Agricultural Research in The Hague. The authors thank Mary-Jane Banks for her valuable assistance in preparing this paper, Todd Davis for providing data on Africans studying in the United States, Johan van Zyl for data and information on the South African university system, and Jock Anderson, Sam Benin, Chris Delgado, Howard Elliott, Peter Hazell, Heike Michelsen, and Manfred Zeller for their useful comments on earlier drafts. This paper is one of a series of papers prepared as part of a joint IFPRI-ISNAR project on Policies for African Agricultural Research and funded in part by DANIDA, USAID, and the World Bank/SPAAR.

¹ See for example Pardey, Roseboom, and Beintema (1997) for an overview of investment and personnel trends in agricultural R&D throughout Africa, including the role of universities. Michelsen et al. (1997) provided some case study evidence on aspects related to the management of R&D in African universities. See also Contant (1988), Eicher (1990), Steele and Mattocks (1991), and White (1990) for a discussion on the contribution of universities to agricultural research in Africa.

policies that address these supply concerns are integral to a more comprehensive assessment of the package of policies required to maintain and further develop a country's agricultural research capacity.

Universities throughout the developed world are confronting many changes. The large increases in student numbers since World War II (partly a baby-boomer effect and partly a reflection of increased enrollment rates) has caused a significant expansion in university facilities and faculties. Moreover, universities have increased their take of generally expanding public research budgets as well. But the rapid increase in privately performed (and funded) R&D, especially in more recent years, has begun to radically reshape the research that universities do, and how they do it. Collaborative research arrangements with the private sector abound, and this spills over to affect the types of training students (particularly postgraduate students) receive, and their job prospects upon graduation. Advancements in the science of biology are blurring, or at least reshaping, the boundaries between the agricultural sciences and other disciplines. And even changes in communication technologies (e.g., the Internet) are blurring the boundaries of universities themselves, making effective distance learning a distinct possibility and changing the basis and nature of collaborative research arrangements as well. The cost of collaborative R&D with a colleague around the world is now little more than the cost of collaborating with one's colleague in an adjoining office.

Some of these developed-world changes are also being faced by policy makers and administrators in African universities (and universities in other less-developed countries),

but the magnitude, timing, and context of the changes are distinctly different and require different policy responses. Public support for higher education in Africa has grown, but is still at very low levels by international standards. The institutions themselves are still comparatively young—many having developed in the post-independence period beginning in the early 1960s—and have less-developed scholastic traditions with limited numbers and generally less qualified personnel to staff them. Much less of the total public agricultural R&D is done by African universities and most staff spend considerably less time on research than do their counterparts in developed countries.²

An important step to understanding the appropriate policy stance to take toward African (agricultural) universities is to have a good grasp of the current state of these universities and the student bodies they support. Placing the universities in the broader context of each country's higher-education sector and comparing that with relevant regional and global developments is also helpful. Our primary purpose in preparing this paper was to assemble the available quantitative evidence on African agricultural universities, place that evidence in a broader sectoral and spatial context, and provide some appropriate policy perspectives based on that evidence.

² Pardey, Roseboom, and Beintema (1997) report that in 1991, 10 percent of the public agricultural R&D in 21 African countries was done by universities, compared with the 1993 OECD average of 43 percent as reported by Pardey, Roseboom, and Craig (1998). Moreover, the majority of African university faculty spent less than 20 percent of their time doing research. This 1991 African estimate is lower than that reported by Michelsen et al. (1997) who surveyed academic staff at a limited number of faculties of agriculture in six African countries and reported that faculty spent between 29 and 35 percent of their time doing research during the mid-1990s.

2. EDUCATION IN AN R&D CONTEXT

When thinking about technological change in agriculture and the respective roles of education and R&D, there are significant education effects that go well beyond their research consequences. The technical changes that agricultural R&D brings about involve new crop varieties, new pest and disease control practices, new fertilizer options, and so forth. Farmers are also provided with new agronomic practices that often have significant site-specific dimensions to them, and which require adaptation to fit these new practices to local circumstances. There is a large volume of literature regarding the rate at which farmers become aware of these new technologies, the speed and extent with which they adopt them, and, if necessary, the degree to which they adapt them for their own, specific uses (see, for example, Birkhaeuser, Evenson, and Feder 1991, and the references therein).

The overwhelming conclusion of this literature is that education (and the basic literacy and numeracy skills that go with it) is the key to increasing the payoff to new technologies by stimulating their adoption rates and the efficient use of the technologies once adopted. For these reasons, access to primary and secondary education is an important engine of growth in agriculture throughout the developed and developing world. Increasingly, access to tertiary education is becoming *de rigueur* for farmers (especially now in developed countries, but surely a trend that will gain ground in developing countries too) enabling them to meaningfully access the new, more

sophisticated technologies becoming available to agriculture and to manage their agricultural firms in an efficient way as the pace of change in the market place picks up.

But, obviously, technical change does not come about without access to new technologies, and it is the education-R&D linkages that drive the rate of innovation in agriculture that are the focus of this paper. Whereas research expenditures can be thought of as investments in knowledge capital, spending on education can be viewed as an investment in the human capital that, in part, makes possible the research. Thus the state of tertiary training in the agricultural sciences is an especially important aspect of a country's capacity to build and maintain an effective R&D system.

THE RETURNS TO INVESTING IN EDUCATION

To summarize the economic consequences of investing in education, economists turn to various measures, most commonly a rate of return measure that draws on basic cost-benefit principles. There are both public and private payoffs to investments in education. To calculate the private returns to individuals (and their families, perhaps) requires an estimate of the relevant costs incurred and the benefits received. From an economic perspective, private costs include the financial costs involved in attending school (such as school fees, if any, and the costs of books and supplies) as well as the opportunity cost of the income forgone by the individual or the family during the time the student spends in school. The benefits are often calculated as the differential income stream (e.g., the higher wages and benefits) that can be attributed to the education, commonly

constructed by comparing the earnings over the life of the individual with education to an individual who is similar in all other important respects, but lacks the education.

To calculate the public (or social) returns to education a similar procedure is used but with different streams of costs and benefits. Here benefits are calculated as the value of the differential output (as distinct from personal income) streams that can be attributed to the education (e.g., educated individuals are generally more productive and generate more output than uneducated individuals). The social costs include not only the opportunity costs of foregone output (which is a cost borne by both the individual and society at large) but also the not inconsiderable sums of public money that governments invest in education. It is these differences in the way the cost streams are calculated that often gives rise to social rates of returns that are lower than private rates.

Psacharopolous (1993 and 1994) descriptively reviewed many of the studies published since the early 1970s (more than 100 in total) that sought to estimate the social and private rates of return to investments in education. As might be expected, private returns were generally higher than social returns.³ Taking the evidence at face value, it is more profitable for a country to invest in primary education (which returns an average of 18.4 percent) than in higher education (average returns of 10.9 percent).⁴ Nonetheless,

³ In general, two methods for calculating rates of return to education have been used: the so-called "elaborate" (or "full") method and the "basic" earnings function. The choice of method used in the various rate of return studies is based on the availability and nature of the data. For a brief description of the two methods see Psacharopoulos (1993, 1994, and 1995).

⁴ In none of his reviews of this literature did Psacharopolous distinguish between those studies reporting average and those marginal rates of return, nor for that matter, between

the reported returns to investments in all levels of education are quite substantial and are generally higher in developing than developed (i.e., OECD) countries. These cross-country differentials are taken to reflect a diminishing returns phenomenon, wherein the marginal dollar yields a lower return in higher-spending, rich countries than in poorer countries with lower intensities of spending on education. Using data on the average rate of return by country, Psacharopolous concluded that the private and social rates of return to education are negatively correlated with per capita income (which is consistent with the developed-developing country differentials just noted). He also observed that the reported, social rates of return appear to be trending down over time and this trend applies to all levels of education.⁵ A final observation was that, overall, the social returns to educating females appear to be higher, on average, than educating males, although this may not be so for some countries and specific levels of education.

Bennell (1996) critically examined 17 of the 18 individual country studies used by Psacharopolous (1994) to derive continental average rates-of-return to education for sub-Saharan Africa. Bennell's main conclusions were that geographically small, anglophone countries were over represented in Psacharopolous' tabulations and that the data used in many of the country studies were of dubious quality leading one to seriously question the

those studies reporting real and nominal returns. These details, and many more, matter when using reported rates of return to make policy inferences, as Alston et al. (1998) describe when reviewing the rate of return to research literature.

⁵ The private rates of return to investment in primary and secondary education decreased as well, but the private returns to investment in higher education increased over the 15-year period.

validity of the evidence (e.g., approximately one half of the African studies derived their estimates of the benefits from education on the basis of guesstimates about relevant income stream differentials).

3. AFRICA'S HIGHER-EDUCATION SECTOR—A BRIEF REVIEW

The past three decades is a period which has seen considerable change in the higher-education sectors throughout Africa. The number of universities in Africa grew markedly from less than 20 (including nine universities in South Africa) in 1960 to nearly 160 by 1996, with correspondingly high rates of growth in the number of students enrolled in higher education. The proportion of expatriate faculty staff in African universities decreased, partly in response to the increased supply of Africans with postgraduate training, and partly a reflection of the reduced donor support for placing expatriates in African universities.⁶ The substantial growth in the number of universities, staff, and students is in stark contrast to the significant cuts in public funding for higher education that have been widespread throughout Africa during the 1980s and continuing into the 1990s.

⁶ Compared with agricultural research institutes, faculties of agriculture employed relatively more expatriates. This is in part a reflection of the higher qualifications required for university positions than for research positions in the agricultural research institutes (Pardey, Roseboom, and Beintema 1998).

COLONIAL HISTORY

Higher-education sectors began to develop in most African countries comparatively recently, for many countries occurring some time between the last years of colonial rule and the early years of independence. However, there are some limited but important exceptions.

In British Africa, several university colleges were established in the late 1940s with strong links to the University of London (through which the degrees were awarded). These colleges were the Gordon College in Khartoum, Sudan (established in 1946); the University College in Ibadan, Nigeria and the University of the Gold Coast, Ghana (both established in 1948); and the Makerere College in Kampala, Uganda (established in 1949)⁷. These colleges mirrored the University of London in terms of their organizational structure and procedures, curricula, admission policies, and so on. They were conceived as largely "self-sufficient" communities and were often established outside urban areas largely in accord with the Cambridge-Oxford style of university education that sought to distance students from their immediate cultural and familial roots as part of the education process (Court 1991). In all, the University of London developed affiliations with seven colleges throughout Africa. During the period 1945 to 1970, students from these affiliated colleges could sit exams and be conferred degrees from the University of London. Although the teaching materials used by the African colleges and the examinations offered by them were similar to those in London, they were modified to fit

⁷ The Fourah Bay College in Sierra Leone was established earlier, in 1827, and became affiliated with the University of Durham in 1876.

better with local, African circumstances, but not in ways that compromised the academic standards of the training offered or the qualification obtained (ACU 1994).

Following political independence in the early 1960s, these colleges were given independent university status but in many instances retained significant institutional ties with the University of London, at least through to 1970. Although the respective African governments funded these universities (in keeping with the British model they continued to largely emulate), they exerted little formal influence over their activities. University administration remained the province of the university councils and senates, which were effectively free to manage their admission, curriculum, and staff recruitment policies as they saw fit (Gaidzanwa 1995).

Like their counterparts in British Africa, the institutes of higher education established throughout French Africa were also modeled after, partnered with, and largely administered by established universities in France, particularly those of Paris and Bordeaux. Contrary to the British model, universities in French Africa were more directly under state control and received significant funding from the government. During the 1950s, “centres de études supérieurs” were established in Dakar (1950), Tananarive (1955), Abidjan (1958), and Brazzaville (1959).⁸ One of the objectives for establishing these local institutes of higher education was to offer local diplomas and degrees that matched the French standards of that time, largely as a means of training the personnel

⁸ The institute in Dakar gained university status in 1959, the institutes in Tananarive and Abidjan became universities shortly after the independence of Madagascar and Côte d’Ivoire, respectively.

required to staff local colonial administrations (Adams, Bah-Lalya, and Mukweso 1991, and Gaidzanwa 1995).

Belgium's colonial education policies differed markedly from those of either Britain or France and were focused almost exclusively on primary education. The Belgians developed only one center of higher education in their colonies, the Louvanium University Center. This center was established in the Congo in 1949 under the authority of the Catholic University of Louvain, which oversaw the operation of the center and helped staff it with outposted faculty members. The center was granted university status in 1957, three years prior to Congo's accession to political independence (Brown Sherman 1990).

Higher-education institutions in South Africa predate those in the rest of Africa by a good many years. During the nineteenth century, a number of training colleges were established with links to the University of London which was responsible for examining South African students. Eventually, by 1873 to be exact, the University of Cape of Good Hope opened and assumed responsibility for examining South African students and, therefore, became the country's first tertiary institution to award degrees. It took until 1952 for all the colleges affiliated with the University of Cape of Good Hope to become independent, degree-granting universities. Ethiopia, one of the few contemporary African countries never to be colonized, established the Hailie Selassi I University in 1961 through a merger of several post-secondary institutions (Brown Sherman 1990).⁹

⁹ During 1935-36, Ethiopia was invaded and then occupied by Italy, but regained its national sovereignty with the help of the British and their allies in 1941.

THE EXPANSIONARY DECADES OF THE 1960S AND 1970S

For several years following independence, the existing African universities, colleges, and centers continued to operate largely as they had done under colonial rule. Any new universities established at this time reflected the structure and style of the existing institutions. These organizations continued to maintain strong links with European (mostly British or French) universities, with the exception of some universities in Nigeria and East Africa that with support from USAID were partnered with various universities in the United States (Wilson 1993; Lynam and Blackie 1994).¹⁰ The university faculties consisted predominantly of expatriates from European and other western countries,¹¹ and the details of the course content, the textbooks used, and so on, mostly mirrored those found in European universities. The curricula, for some years at least, continued to emphasize the humanities and the liberal arts rather than the physical and biological

¹⁰ During the 1960s (and, to a lesser extent, the 1970s) the Ford and Rockefeller Foundations played an important role in the development of a number of African universities in Nigeria, East Africa, and Zaire (specifically the University of Ibadan, University of Khartoum, Makerere University, University of Nairobi, University of Dar Es Salaam, and Lovanium University). For example, the Rockefeller Foundation gave a total of \$1.2 million in grants to these universities in 1961. The main objective of the Foundations' development programs was to train Africans to replace the Europeans that left the countries after independence and to meet the growing demand for graduates by the fledgling but rapidly expanding public sectors during those decades. During the 1970s the role of the Ford and Rockefeller Foundations in support of higher education was assumed by the World Bank and USAID (Coleman with Court 1993).

¹¹ For example, when the University of East Africa was established in 1963, more than 90 percent of its total academic staff were foreigners (Court 1991).

(including agricultural) sciences, engineering, and the social sciences like business and economics.¹²

These past patterns of development and modes of operation gradually gave way as the 1960s progressed. This decade, and the one to follow, witnessed a rapid expansion in the number of universities and correspondingly high rates of growth in the number of students enrolled in higher education. To illustrate, when the Association of African Universities (AAU) was established in 1967, there were nearly 35 universities in Africa, compared with less than 20 universities in 1960. During this expansionary phase the growing numbers of universities and students were generally matched with commensurate increases in public funding for higher education.¹³ The development of higher-education sectors throughout Africa at this time was commonly seen as an integral part of an overall national plan of development, and was often singled out for support by donors.

THE 1980S AND EARLY 1990S—A PERIOD OF CONTINUING CRISIS

The number of students enrolled in higher education continued to expand substantially in Africa during the 1980s and, at a somewhat lower rate, in the early 1990s. This growth occurred within the context of a rapidly growing and comparatively young

¹² During the period 1953-62, 154 students received agricultural science degrees from the five university colleges operating in British Africa at that time. The only university in French West Africa in 1960, in Dakar, did offer courses in the natural sciences, but not in agriculture (McKelvey 1965).

¹³ Total real spending on education for 39 African countries increased from \$3.8 billion (1983 prices) in 1970, to \$6.3 in 1975, and \$10.0 billion in 1980 (Moock 1988).

population, and improving access to primary and secondary education. Most countries, however, did not properly plan for, nor subsequently expand, the capacity of their universities adequately enough to meet the increasing demand for higher education.

Unlike the growth in higher education that occurred in earlier decades, the funding for this sector during the 1980s and 1990s failed to keep pace with the growth in students and facilities. National education budgets declined as governments began to reign in or restructure their spending patterns, often as part of programs of structural adjustment supported by the IMF (International Monetary Fund) and the World Bank, but also in response to a shrinking tax base as many struggling economies throughout the region began to falter. In some cases, war-related expenses and the loss of public funds through public graft, corruption, or mismanagement also took their toll. To illustrate the shift in spending priorities, spending on education in African countries declined from an average of 17 percent of total public spending in 1980 to 15 percent in 1990 (Saint 1992)¹⁴—this compares with 18 percent in 1990 for the United States and 11 percent for the United Kingdom (IMF 1997).¹⁵ Moreover, Saint also estimates that African universities received an average of 19 percent of national education budgets during the period 1980-84, down to 18 percent of a shrinking education budget during 1985-88. The flow of donor support to higher education also slowed as donors shifted their attention away from investments in

¹⁴ African universities receive most of their funding from the public purse. Negrao (1995) estimates that in the early 1990s, an average of 85 and 93 percent of the recurrent budgets of anglophone and francophone African universities, respectively, came from national education budgets.

¹⁵ This included spending by federal, state, and local governments.

higher education, with a greater share of resources being earmarked for primary and secondary education.¹⁶ This was a direct result of the shift in donor attention towards so-called “basic human needs” of which universal access to education was deemed a key component.

The contraction in financial support for the universities combined with the continued, albeit slowing, growth in student numbers led to drastic declines in spending per student. The World Bank (1994) estimates that real spending per student in Africa (base period undefined) declined from an average of \$6,300 in 1980 to \$1,500 in 1988.¹⁷ These fiscal trends have had their expected and unfortunate consequences. Many universities are overcrowded and poorly maintained.¹⁸ Staff salaries have been squeezed too. Blair and Jordan (1994) report that real faculty salaries fell by 30 percent during the period 1980-88 and have continued to decline in many African countries.¹⁹ The World Bank (1994) notes that the 1991 salaries of Nigerian university staff were equivalent to

¹⁶ The financial problems were exacerbated by the reluctance of many governments to commit to multi-year funding, and in some cases, failing to honor agreed budget commitments (Saint 1992).

¹⁷ The World Bank source neither specifies the number of countries included in the African average, nor the base year used to calculate the real spending totals.

¹⁸ For example, the University of Dakar in Senegal was designed to accommodate 3,500 students, but had enrolled nearly 20,000 students in 1991 (World Bank 1994). Saint (1992) reports that the average number of library books per student for 31 African universities declined during the 1980s from 49 books in 1979 to only seven in 1988. By way of comparison, colleges and university libraries in the United States stocked an average of 78 books per student.

¹⁹ See also Pardey, Roseboom, and Beintema (1998) for a discussion on salaries at the agricultural research organizations.

just 10 percent of the purchasing power of their 1978 salaries. Staff turnover is high, and it is difficult to recruit and retain suitably qualified and well-motivated staff. Moonlighting on other, non-university jobs is a common survival strategy for many university staff (Blair and Jordan 1994).²⁰ Unfortunately these trends are ongoing and represent a serious prospect for the future supply of qualified scientists throughout Africa.

4. HIGHER-EDUCATION TRENDS IN AFRICA

There were nearly 160 universities in Africa in 1996,²¹ of which roughly one half were located in just three countries: Nigeria, South Africa,²² and Sudan (with 37, 21, and 21 universities, respectively). Among the 49 countries presently in sub-Saharan Africa, only eight countries do not currently support a local university.

As described above, a sizeable number of universities were originally established as colleges or institutes during the latter years of colonial rule (and the years immediately

²⁰ In 1991, for example, 15 percent of the academic staff at the Makerere University, Uganda held a second job that had some relationship to their speciality, but 25 percent of the faculty received income from operating their own small businesses or from working in second jobs with no direct link to their academic specialties. (Blair and Jordan 1994). At the Department of Rural Development at the Bunda College of Agriculture, Malawi, around 40 percent of the planned positions were left vacant during the period 1993-96 (Zeller, Mataya, and Islam 1997).

²¹ Included also are a number of higher-education institutes in French Africa that provide (agricultural) training at BSc levels or higher, and are therefore relevant for our study.

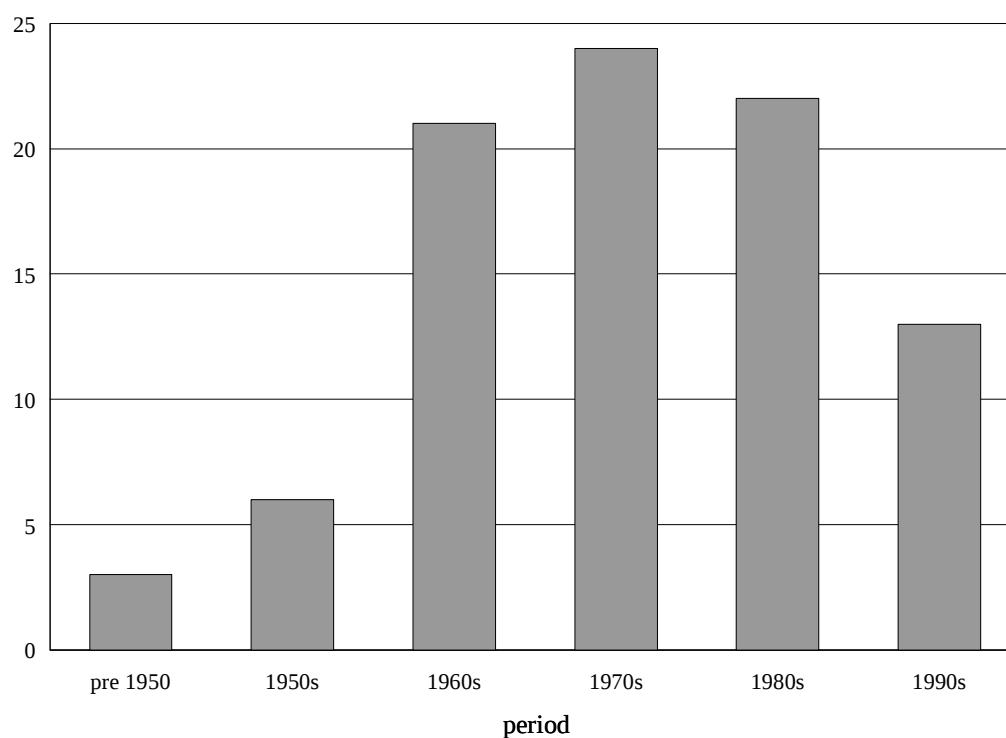
²² Appendix A describes the Nigerian and South African university sectors in more detail.

following independence), later to be granted university status. Thus, in summarizing the pattern of institutional development two pictures are possible, depending on which date of establishment is used. Using the date when a higher-education institution was officially decreed a university, we estimate that more than half of the 92 African universities supporting agricultural faculties (and thereby of special relevance to this study) were established during the decades of the 1960s and 1970s, with further but slowing rates of growth thereafter (figure 1). Setting the date of establishment at the time the predecessor colleges and institutions first opened moves the institutional timeline forward: nearly one third of the 45 higher-education institutions granted university status during the 1960s and 1970s existed in prior forms in earlier years.

In the following subsections we provide a quantitative review of the development of the higher-education sector in Africa in general, focusing more specifically on the role of the agricultural sciences within this sector. To establish the enrollment trends reported below, we drew heavily on the data presented in the *UNESCO Statistical Yearbooks*. But the UNESCO series has some significant limitations. One of our primary interests was to report on enrollments in the agricultural sciences, and compare these with the total enrollment across all fields of studies. We also sought to differentiate these enrollment trends in terms of degree status (for example, distinguishing between bachelors, masters, and doctoral degrees) and to maintain a consistent institutional coverage in the data. Unfortunately the UNESCO data do not always identify university enrollments—of

Figure 1 Establishment dates of African universities with a faculty of agriculture or veterinary sciences

number of universities



Source: Appendix table B.1.

Note: This figure includes 92 of the 96 agricultural universities identified (appendix table B.1) for this study. The dates reflect the establishment dates of the universities, meaning that for many universities it reflect the date a college or institution gained university status and not the establishment date of that college/institution.

special interest here—separate from enrollments in other higher-education institutions such as vocational and technical institutes, and in Africa it is non-university enrollments that often dominate the higher-education totals. Perhaps even more limiting is the fact that the UNESCO data do not always have complete and uniform coverage. For example, data for a number of countries, Nigeria in particular, include only universities, omitting other higher-education institutions and thereby limiting their use in conjunction with the higher-education totals reported for other countries which are more inclusive. For all the series of interest, there was a deficiency of time-series data: the spotty coverage of these data across different countries meant that it was sometimes necessary to aggregate data from similar but not the same years when forming the relevant African totals.

Nonetheless, we believe the broad trends presented here are a representative and plausible account of the evolution of the higher-education sector in Africa and the place of the agricultural sciences within that sector.

ENROLLMENT TRENDS—GLOBAL PERSPECTIVES

Enrollments in African higher-education grew from 119,000 students in 1960 to almost two million in 1995, an annual rate of growth of 8 percent (table 1). Excluding South Africa—which accounted for around one half of the higher education student total in 1960 to one quarter in 1995—the annual growth rate was 10 percent. By international standards this is a very rapid rate of growth; all other developing countries grew an average of 8 percent per annum over the same period and developed countries as a group

grew by 5 percent. This exceptional growth in enrollments in Africa parallels the rapid growth in the number of tertiary education institutions noted above, and reflects the comparatively low enrollment base in 1960 from which the sector subsequently grew. Notably, Africa accounted for only 1 percent of the world's tertiary student total in 1960, and after 35 years of comparatively rapid growth still accounted for only 2.4 percent of the total in 1995 (yet Africa constitutes 10 percent of the world's population and 14 percent of the population under 25 years old).

Table 1 Global trends in higher education enrollments

	1960	1970	1980	1990	1995	Annual growth rate 1960-95
	<i>(thousands)</i>					<i>(percentages)</i>
Sub-Saharan Africa	119	379	563	1,365	1,926	8.3
Other developing countries	2,345 ^a	7,195	16,372 ^a	27,865	35,045	8.0
Developed countries	9,491	20,925	34,225	39,435	44,771	4.5
<i>Global total</i>	<i>11,955^a</i>	<i>28,499</i>	<i>51,160^a</i>	<i>68,665</i>	<i>81,742</i>	<i>5.6</i>
	<i>(percentages)</i>					
Share sub-Saharan Africa in global total	1.0	1.3	1.1	2.0	2.4	--

Source: UNESCO (various issues).

Note: Enrollments are for the higher-education sector, including universities, teacher training colleges, technical colleges, and other higher-education institutions. The data prior to 1980 are not directly comparable with the more recent observations. The UNESCO series for sub-Saharan Africa for the years prior to 1980 exclude Mauritania, South Africa, and Sudan. We added estimates for South Africa obtained from Johan van Zyl of the University of Pretoria to the UNESCO series for the years 1960 and 1970. Unfortunately, adding South Africa to the UNESCO series net of Mauritania, South Africa, and Sudan yields an estimated sub-Saharan African total for 1980 of 812,000 higher-education students, compared with 563,000 students from the 1980 UNESCO estimate that includes these three countries.

^a The data for China, included in other developing and world total, have been extrapolated.

Table 1 also indicates that the number of students seeking higher education has grown more slowly in recent years. This appears to be a worldwide phenomenon, but growth in Africa, while slowing too, is still high by global standards.

The number of students pursuing higher education has increased more rapidly than other parts of most country's education sectors. This has been especially so for developing countries, including many countries throughout Africa. Primary- and secondary-school enrollments in Africa jointly grew by 5.7 percent per annum during the 1960s, compared with 12.3 percent for tertiary education enrollments; during the early 1990s the comparative rates were 3.2 percent for primary and secondary students and 8.5 percent for universities. The number of students enrolled in higher education compared with the number in primary and secondary schools in Africa, is still much lower than elsewhere. In 1995, only two of every 100 students in Africa were enrolled in higher education, substantially more than the 0.7 per 100 students so enrolled in 1960 (table 2). Although this represents a significant improvement since 1960, it is still well below the global average of 7.4 higher-education students for every 100 students in total, and also significantly below the comparable ratio (4.6) for other developing countries. African countries still have a long way before their education sectors catch up to world standards.

Part of the differences in the share of total students seeking higher education no doubt reflects differences in stages of development (as indexed, for instance, by differences in per capita income), but some is also due to differences in the age structure of the population. Countries with fast growing populations (like many of those in Africa) generally have a much larger proportion of younger, school-aged students and a lower

Table 2 Comparative indicators of higher-education enrollments

	1960	1970	1980	1990	1995	Annual growth rate 1960-95
<i>Share of higher education in total enrollment</i>	<i>(percentages)</i>					
Sub-Saharan Africa	0.7	1.2	0.9	1.7	2.0	3.2
Other developing countries	1.0	2.0	2.9	4.2	4.6	4.4
Developed countries	5.3	9.4	14.8	16.8	17.6	3.6
<i>Global total</i>	<i>2.8</i>	<i>4.6</i>	<i>6.0</i>	<i>7.0</i>	<i>7.4</i>	<i>2.8</i>
<i>Tertiary gross enrollment ratio^a</i>						
Sub-Saharan Africa	n.a.	n.a.	1.7	3.1	3.7	--
Other developing countries	n.a.	n.a.	6.2	7.8	9.4	--
Developed countries	n.a.	n.a.	36.4	44.2	50.7	--
<i>Global total</i>	<i>4.7</i>	<i>9.5</i>	<i>13.0</i>	<i>14.0</i>	<i>16.0</i>	<i>--</i>
<i>Student/teacher ratios</i>	<i>(numbers)</i>			<i>(percentages)</i>		
Sub-Saharan Africa	12.9	11.9	13.1	17.5	16.3	0.7
Other developing countries	13.2	13.1	12.5	13.8	15.2	0.2
Developed countries	12.7	13.7	14.1	13.8	13.3	0.1
<i>Global total</i>	<i>12.8</i>	<i>13.6</i>	<i>13.5</i>	<i>13.5</i>	<i>13.8</i>	<i>0.2</i>

Source: UNESCO (various issues).

Note: see table 1.

^a Tertiary gross enrollment ratio is defined as the total number of enrolled students in higher education, regardless of age, as a percentage of the population of the age group that officially corresponds to the level of higher education (20-24 years).

proportion of older people than do countries with slower growing populations. To control for this age effect, table 2 presents comparative estimates of the tertiary gross

enrollment (TGE) ratio.²³ TGE ratios measure the number of students enrolled in higher education (regardless of age) as a share of the 20- to 24-year-old population cohort.

The TGE ratios in table 2 indicate that Africa's higher-education sector lags even further behind the tertiary education sectors of other countries than the higher-education enrollment ratios suggest. In 1995, compared with the 20-24 year cohort, only 3.7 percent of Africans received higher education, against 9.4 percent of the comparable cohort ratio in other developing countries, and a staggering 50 percent among the developed countries. These figures indicate that despite the growth in higher-education enrollments noted earlier (wherein Africa's rate of increase was the fastest in the world), Africa is still well behind in terms of the intensity with which its student-aged population receives higher education.

The final indicator presented in table 2 is the student-teacher ratios for the higher-education sector. This ratio has crept up for most regions of the world (from a global average of 12.8 in 1960 to 13.8 in 1995) showing that the growth in tertiary teacher numbers has failed to keep pace with the growth of student numbers. Some of this may reflect productivity improvements in higher-education (improved distance learning and alternative modes of instruction such as enhanced computer- and Internet-based methods of instruction). But in many instances, especially in the absence of the additional capital improvements required to bring about these productivity improvements, a rise in student-

²³ The net enrollment ratio (defined as the total number of enrolled students in higher education in the age group 20-24, as a percentage of the population in the same age group) would have been more suitable, but no age-specific data are available for students enrolled in higher education.

teacher ratios merely signals an increase in class sizes, deteriorating student access to teachers, and so on, with the consequent decline in the quality of education.

AGRICULTURAL EDUCATION IN AFRICAN UNIVERSITIES

In 1996, 37 of 49 African countries (74 percent) offered some tertiary training (to the degree, certificate, or diploma level) in the agricultural sciences and 15 of the countries (31 percent) had veterinary science programs. Two of these 37 countries offered only agricultural science programs leading to the diploma or certificate level (see appendix table B.1 for specific details). Half of the agriculture and veterinary faculties were located in just three countries (Nigeria, Sudan, and South Africa). Many countries also supported faculties that offer courses in disciplines related to the agricultural sciences (e.g., natural resources and environmental sciences) or maintain separate faculties of forestry or fisheries.

We identified 96 African universities (from a total of nearly 160 universities) that supported faculties of agriculture or agriculturally related sciences in 1996. There was a total of 84 faculties of agriculture throughout Africa that year; at least 77 of these faculties (92 percent) offered BSc degrees and at least half of the faculties offered postgraduate (i.e., MSc or PhD) degrees (figure 2).²⁴ Most of the residual 8 percent of

²⁴ For some faculties, particularly those in non-anglophone countries, we were unable to obtain information regarding the level of training provided. Consequently our data on the degrees offered by each faculty gives a partial, lower-bound estimate of the relevant shares.

the programs that did not confer degrees provided courses that led to a diploma or certificate.

In addition, there were 19 faculties of veterinary sciences throughout Africa in 1996, of which at least 15 (79 percent) offered bachelors degrees. Most of these veterinary medicine programs offered postgraduate degrees as well (figure 3).

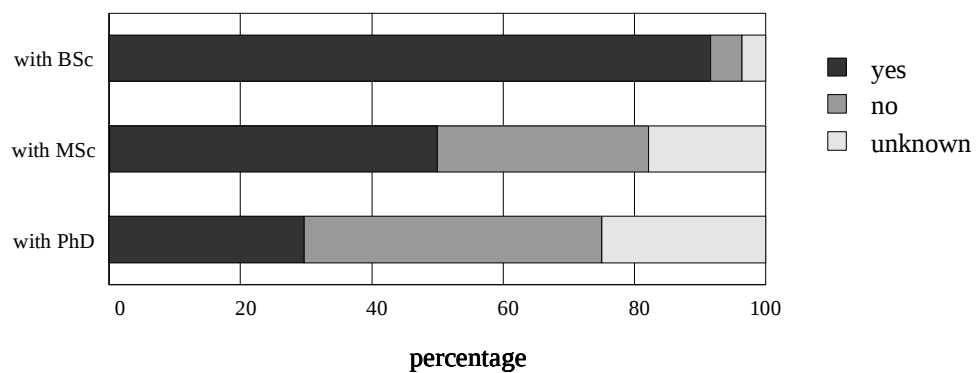
Enrollment Trends

Table 3 summarizes enrollment and graduation trends in the agricultural sciences from the early 1980s to the early 1990s for 21 African countries, and complementary data across all fields of study. The enrollment and graduation data are stratified according to three levels: level five relates to tertiary training that confers a diploma or certificate, level six education leads to a first university degree or equivalent, and level seven studies lead to a post-graduate (i.e., MSc or PhD) degree or its equivalent.

In the early 1990s, just over 11,000 students were enrolled in post-secondary, agricultural courses across 19 African countries (excluding Nigeria and South Africa). Nearly two thirds of these students were studying for bachelors or post-graduate degrees, the remaining one third were taking courses that led to a diploma or certificate. Only 387 (3.5 percent) of these students were seeking a post-graduate degree, 60.7 percent were taking BSc degree courses.

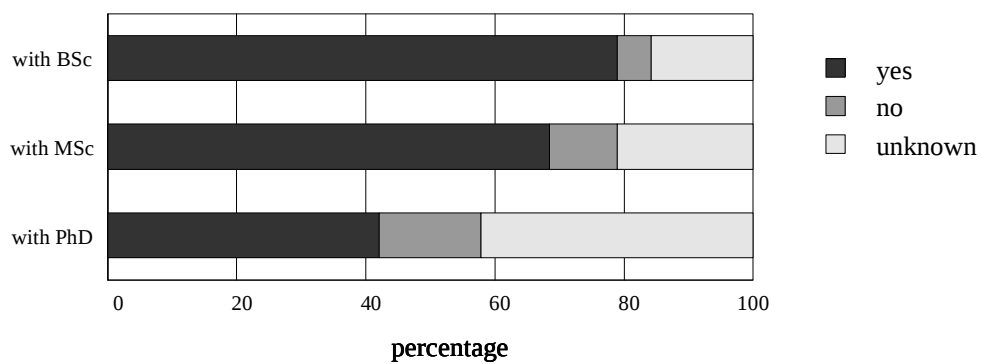
The data coverage for Nigeria and South Africa is less comprehensive but does show there were an additional 2,091 students in the early 1990s seeking post-graduate degrees in the agricultural sciences in these two countries, and a further 25,814 students

Figure 2 Share of faculties of agriculture by degree offered (84 faculties in total)



Source: Appendix table B.1.

Figure 3 Share of faculties of veterinary sciences by degree offered (19 faculties in total)



Source: Appendix table B.1.

Table 3 Student enrollment and graduation trends in the agricultural sciences

	Early 1980s ^a				Early 1990s ^a			
	Level five	Level six	Level seven	All levels	Level five	Level six	Level seven	All levels
<i>19 countries^b</i>	<i>(numbers)</i>							
Enrollment in agricultural sciences	2,824	4,102	491	7,417	3,958	6,700	387	11,045
Enrollment in all fields of study	49,889	70,233	6,430	126,552	121,028	145,030	10,215	276,273
	<i>(percentages)</i>							
Share agriculture in all fields of study	5.7	5.8	7.6	5.9	3.3	4.6	3.8	4.0
Share in total enrollment in agricultural sciences	38.1	55.3	6.6	100	35.8	60.7	3.5	100
Share in total enrollment in all fields	39.4	55.5	5.1	100	43.8	52.5	3.7	100
Graduations as a percentage of enrollment in agricultural sciences ^c	38.0	32.2	53.7	36.2	32.8	21.9	29.9	25.8
<i>Nigeria^d</i>	<i>(numbers)</i>							
Enrollment in agricultural sciences	na	-- 3,931 --		na	na	24,501	1,585	na
Enrollment in all fields of study	na	-- 70,395 --		na	na	207,776	27,333	na
	<i>(percentages)</i>							
Share agriculture in all fields of study	na	-- 5.6 --		na	na	11.8	5.8	na

	Early 1980s ^a				Early 1990s ^a			
	Level five	Level six	Level seven	All levels	Level five	Level six	Level seven	All levels
<i>South Africa</i>								
				(numbers)				
Enrollment in agricultural sciences	na	na	na	na	2,335	1,313	506	4,154
Enrollment in all fields of study	na	na	na	na	218,892	213,372	35,822	468,086
				(percentages)				
Share agriculture in all fields of study	na	na	na	na	1.1	0.6	1.4	0.9
Share in total enrollment in agr. sc.	na	na	na	na	56.2	31.6	12.2	100
Share in total enrollment in all fields	na	na	na	na	46.8	45.6	7.7	100
Graduations as a percentage of enrollment in agricultural sciences	na	na	na	na	21.7	24.1	55.9	26.6

Source: UNESCO (various issues) and ACU (various issues).

Note: Breakdown by level of training follows the International Standard Classification of Education (ISCED) System which defines the three levels as follows: Level five is education at third level, the first stage of the type that leads to an award not equivalent to a first university degree (e.g., diplomas and certificates); level six is education at third level, the second stage of the type that leads to an award equivalent to a first university degree or equivalent; level seven is education at third level, the second stage of the type that leads to an award equivalent to a postgraduate university degree or equivalent. Under the ICSED System, agricultural sciences is defined to include agriculture, veterinary medicine, forestry, and fisheries.

^a Data refer to 1979-81 and 1989-94, respectively (with same year enrollment and graduation statistics for each country). Data for Nigeria refer to 1980/81 and 1991/92, respectively. 1994 enrollment and graduation data were used for South Africa.

^b These data include the following countries: Botswana, Burundi, Congo, Côte d'Ivoire, Ethiopia (incl. Eritrea), Ghana, Lesotho, Madagascar, Malawi, Mali, Mauritius, Mozambique, Niger, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe. For 15 of the 49 countries in sub-Saharan Africa no training in agricultural sciences leading to a BSc degree or higher was available during the early 1990s (of which Namibia only have agricultural training at BSc level since 1994) and, therefore, these countries are not included in this table.

^c Graduation data exclude Congo, Côte d'Ivoire, Mali, Niger, and Togo.

^d Nigerian data only include universities and not all other higher-education institutes. Graduate figures also include post-graduate diploma- and certificate-course students.

studying for bachelors degrees. Nigeria alone had 24,500 students enrolled in BSc courses, much more than the 1,313 enrolled in South Africa and even more than the 6,700 enrolled in the 19 country total reported in table 3.

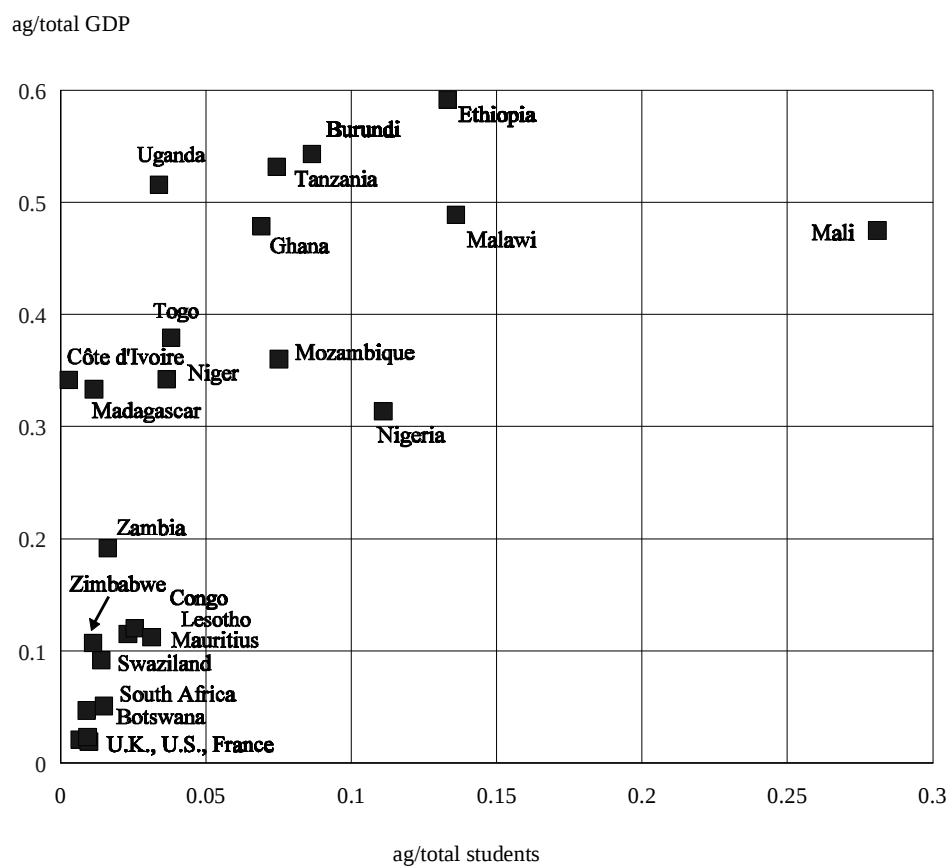
The sample of 19 countries and the Nigerian data confirm that the enrollment trends for the agricultural sciences mirrors the broader, higher-education trends described in table 1. The levels five, six, and seven enrollment totals for the 19-country sample spanning the agricultural sciences grew by about 4.1 percent per annum from the early 1980s to the early 1990s. The level six and seven totals for Nigeria grew by 20.8 per annum for the same period. However, enrollments across all fields of study grew even faster for our 19-country sample. In the early 1990s, 4.0 percent of the total higher-education enrollments were in the agricultural sciences, significantly smaller than the corresponding 1980s share of 5.9 percent. This contrasts with the enrollment trends in Nigeria where the share of agricultural sciences in total enrollments for level six and seven combined increased from 5.6 percent to 11.1 percent for the same period.

These sample average trends mask a good deal of variation and interesting detail at the country level. In the early 1980s, one half of the countries included in the country total had no postgraduate students enrolled in domestic institutions, irrespective of the field of study. Three countries did have postgraduate students, but none in the agricultural sciences. By the early 1990s, only four countries lacked any students in a domestic postgraduate program, although six other countries in the sample reported no postgraduate students in the agricultural sciences.

During the early 1990s, South Africa had only 0.9 percent of its higher-education students enrolled in the agricultural sciences, considerably less than the corresponding share for Nigeria (11.1 percent of levels 6 and 7 students) and the 19-country average (4.0 percent). Comparative shares for the United States, United Kingdom, and France were 0.6, 1.0, and 0.9 percent, respectively. Clearly this reflects a number of factors, not least the structure of the respective economies. The South African economy is less reliant on agriculture than economies elsewhere in Africa. Figure 4 plots the share of agricultural science students in total enrollments against the corresponding agricultural GDP to total GDP ratios for the early 1990s. It shows a reasonably close relationship between these two ratios—as the share of agriculture in total output declines so too does the emphasis on agricultural education among students in higher education programs.

The composition of enrollments in the higher-education sector is also quite variable. In South Africa, for example, 12 percent of the agricultural science students are studying for postgraduate degrees, whereas only 3.5 percent of the students in the 19-country total were seeking PhD and MSc degrees. The data in table 3 also show that postgraduate (level seven) enrollments for the 19-country total were lower in the early 1990s than in the early 1980s. To infer a trend from these two (endpoint) observations may be over interpreting the evidence: post-graduate numbers for fledgling (and now cash strapped, and, often, marginally staffed) programs like those in many of the countries included in this sample may fluctuate from year to year. But it is worrying evidence nonetheless—postgraduate enrollments in the agricultural sciences could well have deteriorated or at least show no signs of having continued to develop throughout the decade of the 1980s and the early 1990s.

Figure 4 Agricultural output shares versus tertiary enrollment shares in agriculture, early 1990s



Source: World Bank (1997) and UNESCO (various issues).

GENDER ASPECTS

The proportion of female African students in higher education has grown from one fifth in 1960 to one third in 1995, but is still well below the corresponding female share for other regions of the world (table 4). Subbarao et al. (1994) concluded, somewhat obviously, that high rates of female literacy combined with high enrollment and graduation rates for girls in primary and, more importantly, secondary schools are among the most important pre-conditions for improving female participation rates in higher education. Unfortunately, throughout much of Africa, female literacy rates and rates of enrollment in secondary schools still fall well behind those of the African male population and those of women in the rest of the world (van Crowder 1997). Van Crowder (1996) also points out that the female share of students enrolled in bachelors and postgraduate degrees is lower than the share of female students enrolled in all higher-education facilities, which suggests that a significant proportion of women enrolled in higher education are pursuing shorter-term vocational or professional training.

Table 4 Females in higher education in Africa

	1960	1970	1980	1990	1995	Annual growth rate 1960-95
(percentages)						
Share of female students						
Sub-Saharan Africa	22.0	23.8	22.0	32.1	34.6	1.3
Other developing countries	23.4	29.2	34.8	39.1	40.7	1.6
Developed countries	35.3	40.7	49.0	51.2	52.4	1.1
Global total	32.8	37.6	44.2	45.9	47.0	1.0

Source: UNESCO (various issues).

Note: see table 1.

Female participation rates in the agricultural sciences in Africa are substantially lower than (generally half) the participation rates across all fields of study (table 5). Moreover, there is a good deal of variation across countries that is not evident from the averages reported in table 5. Female participation rates among students taking degrees in the agricultural sciences were as low as 3 percent in Liberia and as high as 58 percent in Lesotho.²⁵

Table 5 Female enrollments in the agricultural sciences, early 1990s

	Level five	Level six	Level seven	All levels
	(percentages)			
20 countries ^b				
Share of female students in agricultural sciences	14.3	13.7	11.0	13.8
Share of female students in all fields of study	29.1	23.3	21.9	25.5
South Africa				
Share of female students in agricultural sciences	26.8	22.2	15.6	24.0
Share of female students in all fields of study	48.0	51.5	43.2	49.3

Source: UNESCO (various issues).

Note: For definitions of different education levels see table 3. No data were available on the female students at Nigerian higher education institutions.

^a Data refer to 1990-93. 1994 enrollment were used for South Africa.

^b These data cover the following countries: Burkina Faso, Burundi, Côte d'Ivoire, Ethiopia (incl. Eritrea), Ghana, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Niger, Rwanda, Swaziland, Tanzania, Togo, Uganda, and Zambia. For 15 of the 49 countries in sub-Saharan Africa no training in agricultural sciences leading to a BSc or higher was available in the early 1990s (of which Namibia only have agricultural training at BSc level since 1994) and, therefore, these countries are not included in this table.

²⁵ Roseboom and Beintema (1996) also point out that in 1991 the share of female agricultural science faculty in a sample of 19 African countries was only 8 percent, well below the 14 percent average participation rate among female students in that sample in that year, and the corresponding 17 percent of female staff in the respective agricultural R&D agencies. Saint (1992) notes that many of the female university faculty hold more junior positions.

OVERSEAS TRAINING

A cross-country comparison of student enrollments in the agricultural sciences does not necessarily convey the right picture regarding the number of students from a country receiving agricultural science training. Universities in some African countries attract enrollments from other countries in the region and there continues to be a sizable number of African agricultural students receiving training from universities elsewhere in the world. Given that African programs of higher education in the agricultural sciences are of comparatively recent origin, much of the rapid growth in the number of agricultural scientists working for national research agencies over the past several decades implied a significant reliance on overseas training to provide the qualified scientists to staff these agencies. In this section we seek to quantify the extent and nature (e.g., degree level) of that overseas training as well as changes over time in the number of African students and overseas countries involved.

Table 6 provides UNESCO data that measures the number of African students enrolled in higher-education courses at overseas institutes. Here, “overseas” is taken to mean countries other than those in Africa, so the interregional flows of students are not captured by these data.²⁶ Moreover, the available data do not include some significant host countries (such as Brazil, India, Lebanon, and Sweden) and also fail to report students from a few (comparatively small) African countries studying abroad.

²⁶ Sub-Saharan African students studying “overseas” are taken here to include those studying in North Africa. In the early 1990s, a total of 2,354 African students were studying in Algeria, Morocco, or Tunisia, nearly 3 percent of the total number of Africans studying overseas.

Consequently the picture is partial, but revealing, and probably representative of the major trends.

Table 6 African Students enrolled overseas

	Early 1970s	Early 1980s	Early 1990s
United States	7,838	34,522	17,123
France	5,182	16,634	25,924
United Kingdom	5,092	10,232	7,377
Canada	1,281	2,578	4,199
Belgium	1,571	2,493	5,043
Portugal	101	72 ^c	1,400 ^c
Other ^a	9,320	16,689	27,568
<i>Total^b</i>	<i>30,385</i>	<i>83,220</i>	<i>88,634</i>

Source: UNESCO (various issues).

Note: Students that are studying in other sub-Saharan African countries are not included.

^a Data exclude some of the major host countries such as Brazil, India, Lebanon, and Sweden. For the host countries included, some higher institutes were excluded from the data set. Data also exclude 7,390 and 1,538 Sudanese students who followed courses at the Khartoum branch of the University of Cairo in the early 1980s and 1990s, respectively, but were reported to be studying in Egypt.

^b Data exclude foreign students from Cape Verde, Comoros, Djibouti, Equatorial Guinea, Guinea Bissau, Namibia, Reunion, and Sao Tome.

^c Because Cape Verde and Guinea Bissau are excluded actual numbers of Africans studying in Portugal were considerably higher than the data presented in this table.

In the early 1990s, just over 88,600 students from a sample of 41 African countries were studying abroad, mainly in developed countries (table 6). This was equivalent to about 6 percent of the total number of African students enrolled in domestic and foreign higher-education programs. Combining the data in table 6 with the information in table 3, we estimate that at least 10 percent of the African students seeking BSc or postgraduate

degrees (i.e., excluding other, non-degree training from the respective higher-education totals) in the early 1990s were studying overseas.²⁷

Comparing these data with data in table 1 reveals that during the 1970s, the number of African students studying abroad grew rapidly (at 5.2 percent per annum), paralleling the rapid (4.0 percent per annum) growth that occurred in domestic enrollments in higher education. However, while domestic enrollments continued to climb during the 1980s and into the early 1990s—albeit at a slower rate than the previous decade—overall growth in the numbers of students studying abroad effectively stalled. There were two offsetting developments during the 1980s: the number of students from former French, Portuguese, and Belgian colonies studying abroad during the 1980s continued to grow by 2.7 percent per annum, but this was offset by a 2.0 percent per annum contraction in the number students from former British colonies enrolled in overseas studies. Much of this decline was driven by a fivefold drop in the number of Nigerian students studying overseas.

By the early 1990s, 29 percent of the African students studying abroad were in France, 19 percent in the United States, and 8 percent in the United Kingdom. The fourfold increase in African students studying in the United States during the 1970s and early 1980s, was followed by a 50 percent decline in this figure by the early 1990s. This

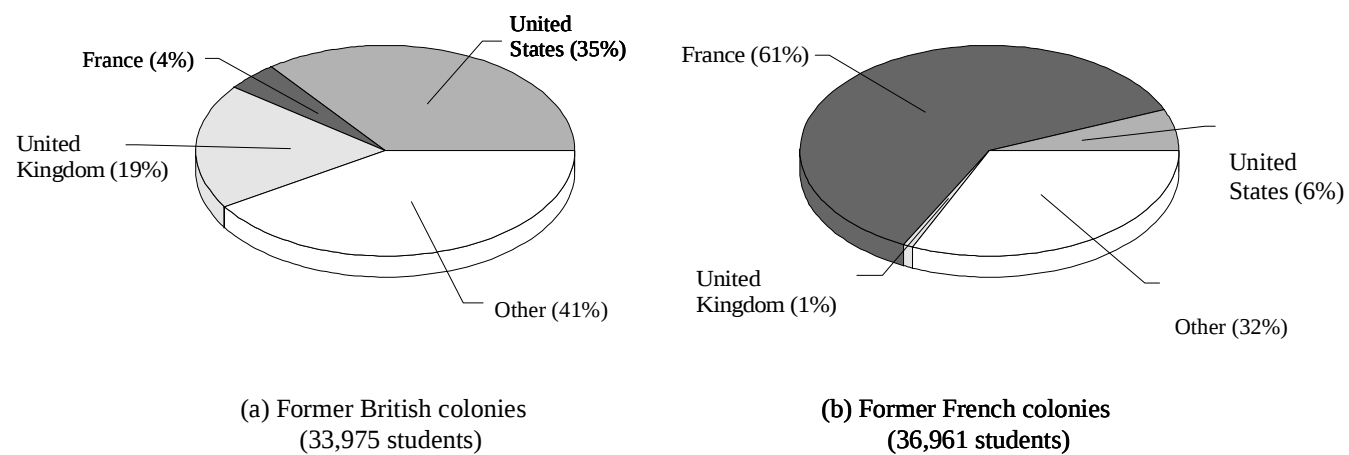
²⁷ Excluding South Africa (with only 0.6 percent of its students enrolled overseas in the early 1990s), we estimate using our data that at least 16 percent of the African students seeking BSc or postgraduate degrees in the early 1990s were studying overseas. Our estimate is lower than the corresponding 20 percent estimated by Kidd (1990).

reflects a tenfold decline in the number of Nigerian students studying in the United States at that time.²⁸

The link between a student's country of origin and the country of study represents a complex interaction between various institutional and personal ties as well as language and cultural barriers, funding availability and the strings that come with that funding, and so on. The former pattern of colonization (and the subsequent policies of these colonial governments) plays a part in shaping many of these aspects. Figure 5 summarizes the links between country of origin and country of study, stratified according to the colonial connections of the country of origin for all Africans studying overseas in the early 1990s. About 38 percent of the Africans studying abroad were from former British colonies, 42 percent were from former French colonies, and the remaining 20 percent came from former Portuguese and Belgium colonies and other African countries. Among those students from countries with British pasts, more than one third opted for higher-education courses in the United States, only 19 percent sought to study in the United Kingdom. Almost two thirds of the students from former French colonies that studied abroad were enrolled in French institutions, reflecting, in large part perhaps, a significant language effect. About 36 percent of the overseas students from former Portuguese colonies opted for studies in Portugal, about 44 percent of the students from former Belgium colonies studied in Belgium.

²⁸ The Nigerian share of all African students studying in the United States fell from more than 50 percent in the early 1980s to just 13 percent a decade later. The marked decline in African students studying in the United Kingdom during the 1980s also reflects a precipitous decline in the number of Nigerians studying there (from 40 to 12 percent).

Figure 5 Colonial background for African students enrolled abroad by location of study, Early 1990s



Source: UNESCO (1995).

Note: See table 6.

Unfortunately, comprehensive data on the degree orientation and field of study of these overseas students are unavailable. Davis (1998) provides some data along these lines, but only for the United States (table 7), where more than three quarters of the African students enrolled in the agricultural sciences at U.S. universities in 1995-96 were pursuing post-graduate degrees (for students from Nigeria this share was around 90 percent). This is much higher than the share of African students across all fields in the United States pursuing post-graduate degrees, which was only 33 percent in 1995-6.

Table 7 African students enrolled in the United States, 1995/96

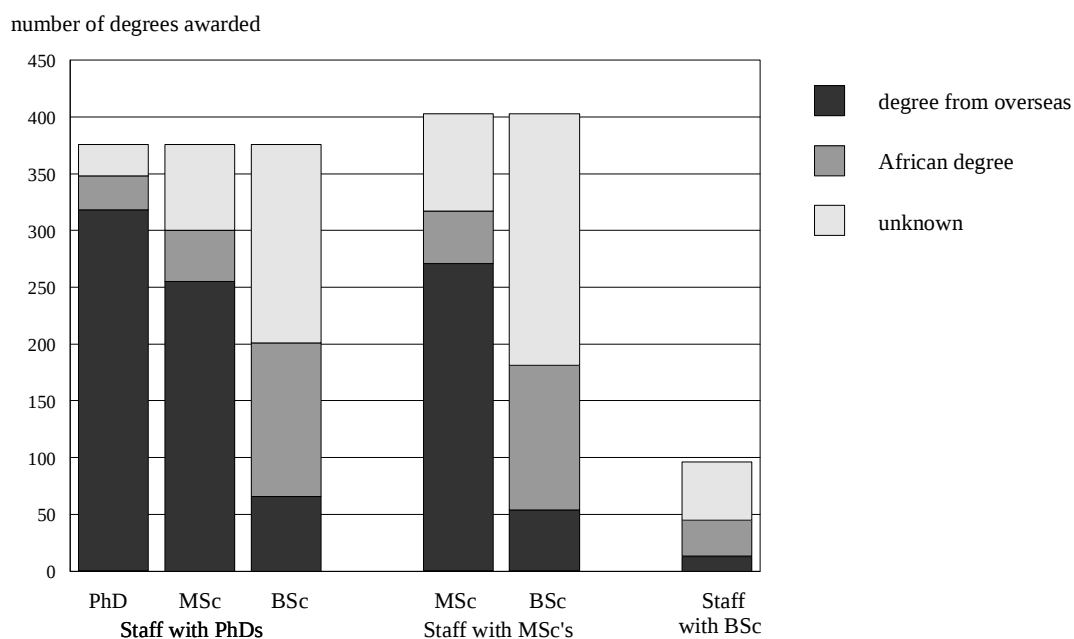
	All fields of study			Agricultural sciences		
	Total	Share of BSc	Share of post-graduate	Total	Share of BSc	Share of post-graduate
	(numbers)	(percentages)		(numbers)	(percentages)	
Sub-Saharan Africa (total)	17,417	66.5	33.5	771	21.3	78.7
Nigeria	2,093	66.3	33.7	40	10.5	89.5
South Africa	1,888	54.7	45.3	34	29.4	70.6

Source: Davis (1998).

Some related data on the country-of-origin of degrees held by university staff working in 34 agricultural science and related faculties in ten anglophone countries in Africa were compiled from staff listings obtained from member universities of the Association of Commonwealth Universities (ACU). These data also distinguished faculty by their highest degree earned and are summarized in figure 6. The

Figure 6 Country of origin of degrees obtained by national faculty staff in agricultural R&D

Case study of 10 anglophone countries for 1991



Source: Compiled by authors from faculty listings in ACU (various issues).

Note: Countries included are Ghana, Kenya (1993), Lesotho (1993), Malawi (1992), Mauritius, Swaziland, Tanzania, Uganda, Zambia (1992), and Zimbabwe. Data for 1991, except for those countries with other years within brackets. In total, 34 university faculties and agricultural R&D institutes were included in the data presented in this table.

preponderance (at least 85 percent) of national staff with a PhD degree earned that degree overseas. About two thirds of these staff with doctoral degrees received also their MSc training overseas, close to the share of staff with MSc degrees who were also foreign trained. Averaging across all faculty reported in figure 6, at least 14 percent of the BSc degree were obtained outside of Africa.

A critical concern for African policy makers is the number of African students that fail to return home on completion of their studies, or, having once returned, subsequently leave the country. Unfortunately, little hard data are available to truly assess the extent of this behavior. Saint (1992) claims that the rate of migration of highly skilled Africans to developed countries increased rapidly from 1,800 per annum during the period 1960-74, to 4,400 annually during 1975-84, and 23,000 in 1987 alone. Saint also notes that a non-cited UNCTAD study suggests that 30 percent of the total stock of “highly skilled” Africans reside overseas. Maliyamkono, Ishumi, and Wells (1982) surveyed a number of donor agencies operating in five countries throughout Eastern Africa in the early 1980s. These agencies reported that 5 percent of the students from these countries studying abroad did not return after completing their studies. Ballenger and Klotz-Ingram (1997) cite a report by Finn, Pennington, and Hart-Anderson (1995) which estimates that 23 percent of foreign students who received U.S. doctoral degrees in agricultural and biological engineering in 1984, were still working as temporary residents in the United States in 1992.²⁹

²⁹ The corresponding figure for students across all the sciences and engineering was as high as 42 percent.

Certainly this outflow of human capital is not unique to African countries nor the agricultural sciences. And no doubt it has serious consequences. For example, a shortage of qualified staff is a serious problem confronting many African universities; Blair and Jordan (1994) report that in the early 1990s, an average of 46 percent of the academic positions in the environmental, biological, and agricultural sciences (including veterinary medicine) at the University of Makerere, Uganda were unfilled. Without good career prospects, and salaries that are competitive in some senses, it will be difficult to stem this outflow, or, indeed, reverse it. But it is possible, as Indonesia's experience during the 1980s and early 1990s, for example, illustrates. Attention to detail in policy matters is important in seeking to maximize the incentives for trained nationals to return within the resources a country has to work with, although overall rates of growth (and, importantly the prospects for future growth) are fundamentally important.

5. CONCLUSION

The rapid growth in the number of universities and the number of students enrolled in higher education throughout Africa is cause for some optimism. But the dramatic deterioration in public spending per student, and the still substantial gap between enrollment ratios in higher education throughout much of Africa compared with other regions of the world, provides a very pessimistic picture for the immediate (and, perhaps, longer-term) prospects of agricultural R&D. Research requires a steady supply of new

ideas and new human capital, both things that universities are, or ought to be, in a position to provide.

The current plight of African universities is deserving of serious policy attention within Africa and by donors alike. We have documented a stagnation in the number of Africans seeking higher education abroad over the past decade or so, a development that reflects not only a tightening of the public purses throughout Africa but a leveling in the growth of donor support too. There is a sense, perhaps, among donors that they have already made these investments in education. But to maintain a healthy stock of human capital in a country requires a continuing investment commitment, not merely a one-shot round of investments. This is especially so in Africa where they still have a long way to go before they reach the norms regarding enrollment ratios, staff-student ratios, and so on that pertain to much of the rest of the world.

The evidence also suggests that there is a preponderance of higher-education students (across all fields of study) seeking bachelors degrees through overseas studies. But this evidence may not be indicative of the situation regarding the agricultural sciences as suggested by the data for the United States where two thirds of the African students were enrolled in post-graduate programs. Certainly this seems to have been true in the past, but it may not be so now. Sending students overseas for BSc degrees seems a potentially costly exercise compared with the alternative of providing that option through local universities.³⁰

³⁰ Zeller, Mataya, and Islam (1997) estimate that the resources spent on sending one student overseas for MSc training, was equivalent to the cost of training five or six students at African universities.

Although research and teaching often go hand in hand within a university, and is especially important in the pursuit of higher-education, a clear policy option that stems from our analysis of the available data is that some specialization may be warranted. Given the current lack of qualified university staff, and the resources to support them, it may be cost effective for some universities to forgo significant research programs and focus on undergraduate (and, perhaps, MSc) teaching programs. Often this is not a popular idea with faculty, but if staff were adequately rewarded in terms of salary and benefits and facilities, it may be much preferred over current conditions. Certainly the education market in the United States and elsewhere has seen much specialization and product differentiation among universities in recent years, with some universities maintaining fully fledged research and teaching programs, others specializing in research-oriented degrees, and many developing reputations as centers of excellence in undergraduate teaching. Policies that strive to treat all universities equally regarding the balance of effort between teaching and research, are unlikely to be particularly cost effective.

REFERENCES

- ACU (Association of Commonwealth Universities). Various issues. Commonwealth Universities Yearbook: A Directory to the Universities of the British Commonwealth and the Handbook of Their Organisation. London: ACU.
- Adams, M.N., I. Bah-Lalya, and M. Mukweso. 1991. Francophone Africa. In *International Higher Education: An Encyclopedia*, vol. I, ed. P.G. Altbach, pp. 349-74. Chicago and London: St. James Press.
- Alston, J.M., M.C. Marra, P.G. Pardey, and T.J. Wyatt. 1998. Research returns redux: a meta-analysis of agricultural R&D evaluations. Draft IFPRI Research Report, Washington D.C.: International Food Policy Research Institute (forthcoming).
- Ballenger, N. and C. Klotz-Ingram. 1997. Training foreign agricultural scientists: Toward assessing U.S. benefits. Paper prepared for the ERS-Farm Foundation workshop on Public-Private Collaboration in Agricultural Research, August 15, 1997, Rosslyn, Virginia, U.S.A.
- Bennell, P. 1996. Rates of return to education: Does the conventional pattern prevail in sub-Saharan Africa? *World Development* 24 (3) (January): 183-99.
- Biraimah, K. 1991. Nigeria. In *International Higher Education: An Encyclopedia*, vol. I, ed. P.G. Altbach, pp. 399-410. Chicago and London: St. James Press.
- Birkhaeuser, D., R.E. Evenson, and G. Feder. 1991. The economic impact of agricultural extension: A review. *Economic Development and Cultural Change* 29 (3) (April): 607-50.
- Blair, R. and J. Jordan. 1994. Staff loss and retention at selected African universities: A synthesis report. AFTHR Technical Note No. 18, September. Washington, D.C.: World Bank.
- Brown Sherman, M.A. 1990. The universities in modern Africa: Toward the twenty-first century. *Journal of Higher Education* 61 (4) (July-August): 363-85.
- Coleman, J.S., with D. Court. 1993. *University development in the Third World: The Rockefeller Foundation experience*. Oxford, New York, Seoul, and Tokyo: Pergamon Press.
- Contant, R.B. 1988. Linking agricultural research and higher education: A partnership for success. Staff Notes No. 88-39, December. The Hague: ISNAR.

- Court, D. 1991. The development of university education in sub-Saharan Africa. In *International Higher Education: An Encyclopedia*, vol. I, ed. P.G. Altbach, pp. 329-47. Chicago and London: St. James Press.
- Davis, T.M., ed. 1998. Open doors 1996/97: Report on international educational exchange, 1997. New York: Institute of International Education.
- Eicher, C.K. 1990. Building African scientific capacity for agricultural development. *Agricultural Economics* 4 (2) (June): 117-43.
- FAO (Food and Agriculture Organization). 1996a. *Agricultural education and training institutions in Anglophone Africa*. Rome: FAO.
- FAO (Food and Agriculture Organization). 1996b. Directory of educational institutions where agriculture is a major subject in Francophone Africa. Rome: FAO. Mimeo.
- Finn, M.G., L.A. Pennington, K. Hart Anderson. 1995. Foreign nationals who receive science or engineering PhD's from U.S. universities: Stay rates and characteristics of stayers. April. Oakridge Institute for Science and Education.
- Gaidzanwa, R.B. 1995. Governance issues in African universities: Improving management and governance to make African universities viable in the nineties and beyond. Background paper for the Joint Colloquium on the University in Africa in the 1990's and Beyond, January 16-20, Lesotho.
- IAU (International Association of Universities). 1996. International handbook of universities, 14th ed. Berlin/New York: de Gruyter.
- IMF (International Monetary Fund). 1997. *Government Finance Statistics Yearbook 1997*. Washington, D.C.: IMF.
- Kidd, C.V. 1990. The education of sub-Saharan university students in foreign countries. *Discovery and Innovation* 2 (1) (March): 19-32.
- Lynam, J.K. and M.J. Blackie. 1994. Building effective agricultural research capacity: the African challenge. Chapter 7 in *Agricultural Technology: Policy Issues for the International Community*, ed. J.R. Anderson, pp. 106-34. Wallingford, U.K.: CAB International.
- Maliyamkono, T.L., A.G.M. Ishumi, and S.J. Wells. 1982. *Higher education and development in eastern Africa: An eastern African universities research project report on the impact of overseas training and development*. London: Heinemann.

- McKelvey, J.J. 1965. Agricultural Research. In *The African world: A survey of social research*, ed. R.A. Lystad, pp. 317-51. New York, Washington, D.C., and London: Praeger.
- Michelsen, H., C.H. Hoste, D. Shapiro, and L.W. Zuidema. 1997. The role of universities in NARS: A synthesis of a study of six countries in sub-Saharan Africa. Paper presented at the international workshop on Strengthening the Role of Universities in the National Agricultural Research System in Sub-Saharan Africa, November 17-21, Cotonou, Benin.
- Moock, P.R. 1988. *Education in sub-Saharan Africa: Policies for adjustment, revitalization, and expansion*. January. Washington, D.C.: World Bank.
- Muller, J. 1991. South Africa. In *International Higher Education: An Encyclopedia*, vol. I, ed. P.G. Altbach, pp. 411-23. Chicago and London: St. James Press.
- Negrao, J. 1995. Adequate and sustainable funding of African universities. Background paper for the Joint Colloquium on the University in Africa in the 1990's and Beyond, January 16-20, Lesotho.
- Pardey, P.G., J. Roseboom, and N.M. Beintema. 1997. Investments in African agricultural research. *World Development* 25 (3) (March): 409-23.
- Pardey, P.G., J. Roseboom, and N.M. Beintema. 1998. Cost aspects of African agricultural research. IFPRI and ISNAR, Washington, D.C. and The Hague (forthcoming).
- Pardey, P.G., J. Roseboom, and B.J. Craig. 1998. Agricultural R&D investments and impacts. Chapter 3 in *Paying for Agricultural Productivity*, ed. J.M. Alston, P.G. Pardey, and V.K. Smith. Book length manuscript. Washington, D.C.: International Food Policy Research Institute (forthcoming).
- Psacharopoulos, G. 1993. Returns to investment in education: A global update. Policy Research Working Paper No. WPS 1067. January. Washington, D.C.: World Bank.
- Psacharopoulos, G. 1994. Returns to investment in education: A global update. *World Development* 22 (9) (September): 1325-43.
- Psacharopoulos, G. 1995. The profitability of investment in education: Concepts and methods. Human Capital Development and Operations Policy No. HCOWP 63. November. Washington, D.C.: World Bank.

- Roseboom, J., and N.M. Beintema. 1996. Taking count: Female agricultural researchers in sub-Saharan Africa. *CG Gender Lens* 1 (1) (July): 8.
- Roseboom, J., N.M. Beintema, P.G. Pardey, and E.O. Oyedipe. 1994. Statistical Brief on the National Agricultural Research System of Nigeria. Statistical Brief No. 15. December. The Hague: ISNAR.
- Saint, W.S. 1992. Universities in Africa: Strategies for stabilization and revitalization. World Bank Technical Paper No. 194. Washington, D.C.: World Bank.
- Steele, R.E. and D.M. Mattocks. 1991. The attrition of institutional capacity among sub-saharan agricultural universities: An impediment to the operation and development of national agricultural research systems. Paper presented at the Association of Faculties of Agriculture in Africa Seventh General Conference on Agricultural Research and Development, June 10-14, Nairobi, Kenya.
- Subbarao, K., et al. 1994. Women in higher education: Progress, constraints, and promising initiative. Discussion Paper No. 244. June. Washington, D.C.: World Bank.
- UNESCO (United Nations Educational, Scientific and Cultural Organization). 1996. *World Guide to Higher Education: A Comparative Survey of Systems, Degrees and Qualifications*. Paris: UNESCO.
- UNESCO (United Nations Educational, Scientific and Cultural Organization). Various issues. *Statistical Yearbook*. Paris: UNESCO.
- Van Crowder, L. 1996. Enrollment of women in agricultural studies at intermediate and higher levels of education. March 31, 1996.
<<http://www.fao.org/waicent/faoinfo/sustdev/EXdirect/EXan0002.htm>> (accessed May 16, 1997).
- Van Crowder, L. 1997. Women in agricultural education and extension. April 10, 1997.
<<http://www.fao.org/waicent/faoinfo/sustdev/EXdirect/EXan0016.htm>> (accessed May 16, 1997).
- Van Rooyen, J., R. Barnard, and J. van Zyl. 1996. Agricultural education and training in South Africa: An overview. *Development Southern Africa* 13 (5) (October): 713-31.
- White, L.G. 1990. Increasing the relevance of agricultural research: Institution building in third world universities. *Journal of Developing Areas* 24 (July): 451-66.

- Wilson, L.A. 1993. The role of developing countries' universities in national agricultural research systems (NARS). Chapter 4 in *The Role of Universities in National Agricultural Research Systems*, ed. FAO (Food and Agriculture Organization), pp. 57-123. Rome: FAO.
- World Bank. 1994. *Higher education: The lessons of experience*. Washington, D.C.: World Bank.
- World Bank. 1997. World Development indicators 1997. April. World Bank, Washington, D.C. CD-ROM.
- Zeller, M, C. Mataya, and Y. Islam. 1997. Strengthening capacity for food, agricultural, and nutrition policy analysis in sub-Saharan Africa: An overview of the literature, and lessons learnt from Malawi. Outreach Discussion Paper No. 15. April. Washington, D.C.: International Food Policy Research Institute.

Appendix A: The Development of Nigerian and South African Universities

The size and regional significance of the Nigerian and South African university sectors means that developments regarding universities in these two countries are deserving of some additional details, as provided below.

Nigerian universities³¹

Close to one quarter of the total number of universities in Africa, around one third of the total number of faculties of agriculture, and one quarter of the faculties of veterinary sciences, are located in Nigeria. The British colonial past of Nigeria has left its mark on the universities. Most universities are managed by a council and a senate who are jointly responsible for administration, and a vice-chancellor who coordinates the academic and administrative functions between these two bodies. The Nigerian government nominates the chancellors and a number of outside members of the council, but does not exert much other influence on the internal governance of the universities.

The University College in Ibadan (which was granted university status and renamed the University of Ibadan in 1962) was established in 1948 and was linked to the University of London (which provided the degrees). Soon after independence, in 1960, three regional universities were established following the recommendations of the Ashby commission on post-secondary certificate and higher education: the University of Nigeria in Nsukka in 1960, the University of Ife in 1962 (renamed Obafemi Awolowo University in 1987), and the Ahmadu Bello University in 1962. The development of these three regional universities was supported by USAID through contacts with a number of U.S. universities. Together with the University of Lagos and University of Benin (established in 1962 and 1970, respectively), these six campuses represent Nigeria's "first generation" universities. The Ashby commission also suggested that these universities should be autonomous (regarding their internal policies) and national in outlook (by admitting students from all regions). An important concern was the "Africanization" of faculty staff and the structure of the curriculums.

In the mid-1970s seven more universities (the so-called "second generation" universities) were established in conjunction with the political restructuring of the country into 12 states (three of these universities were founded as university colleges and became independent universities a few years later). In the early 1980s, during the oil boom era, seven additional federal universities of technology were established. The number of universities expanded to 20 federal and eight state universities by 1983, with the new campuses being dubbed the set of "third generation" universities. As a result of declining oil revenues the expanding number of universities was not matched by the financial

³¹ This section draws heavily from Biraimah (1991), Roseboom et al. (1994), and ACU (1997).

resources needed to support them. In 1984 the federal government opted to downgrade four of the seven federal universities of technology to university colleges and incorporate them into other, existing universities. This restructuring was partly reversed in 1988 and two of the four technology university colleges were reconstituted as universities of agriculture (i.e., Abeokuta and Makurdi). A third university of agriculture was established in 1992 (i.e., Umudike). The creation of some new states in the early 1990s has led to a further restructuring of the state university system. The National Universities Commission (NUC) was established in 1962 following the recommendations of the Ashby commission. In its early years, NUC played an advisory role, but since the mid-1970s (as a result of a number of government decrees) the commission is now responsible for coordinating the federal universities and overseeing their budgets.

Currently there are 37 universities in Nigeria.³² The 25 federal and the 12 state universities are almost totally funded through various federal and state grants, respectively. The economic downturn of the early 1980s (due to declining oil revenues) combined with a significant increase in the number of universities meant that government funding (both at state and federal level) for each universities declined precipitously (e.g., in 1987 the total recurrent grants to federal universities in real terms were less than half their 1983 level, and total capital grants were only one third of their 1983 level). The impact of these funding cuts were serious; there were across-the-board reductions in the supply of books, journals, laboratory equipment, postgraduate training abroad, furniture, and so on. As a response to this situation, real recurrent grants to universities increased by 50 percent between 1987 and 1994, a nominal ninefold increase in funding (but with a continuing decline in total capital grants). This increase in domestic sources of funding was accompanied by a World Bank facility to provide additional, loan funds of \$120 million for the university sector, but only part of these funds were released. In 1993 the Nigerian government also introduced an education tax of 2 percent on all assessable profits of companies registered in Nigeria, and the higher-education sector is receiving half of this tax.

The increasing demand for higher education resulted in a substantial increase in enrollments, from 70,395 students in 1980/1 to 235,109 in 1991/2. About 12 percent (27,333 students) of the higher-education total in 1991/92 were enrolled in postgraduate studies. In light of this extraordinary growth in enrollments and the simultaneous decline in federal grants during much of the 1980s, a policy to limit student enrollments was introduced. The first generation universities were now required to limit the increase in their student populations to no more than 2.5 percent per annum, the second and third generation universities had their annual growth rates capped at 10 and 15 percent, respectively.

³² The higher-education system in Nigeria extends well beyond these universities to include a large number of polytechnics and colleges of technology, colleges of education, and other post-secondary schools of basic studies, arts, and sciences.

The continued overseas exodus of educated Nigerians, together with the comparatively low salaries afforded university staff has limited the number and lowered the quality of the university faculty. These factors, when combined with the rapid growth in the number of students, has led to a significant increase in student-teacher ratios; the ratio increased from 12 students per faculty in 1985-86 to 15 students by 1989-90.³³ This pattern of under staffing has been especially severe in law, administration, and the sciences, and has had an especially noticeable effect regarding the more senior faculty positions.

Nigeria has three universities of agriculture that were recently placed under the authority of the Ministry of Agriculture. A further 23 universities have faculties of agriculture (of which five universities also have a faculty of veterinary sciences), and an additional two universities do not have faculties of agriculture or veterinary sciences but do have faculties in the various sciences related to agriculture. The number of courses in specialized fields related to agriculture increased markedly as a consequence of the expansion from the five universities with faculties of agriculture (and one with postgraduate training) in 1965 to the 26 universities with faculties of agriculture and related sciences in the 1990s (table A.1).

South African universities³⁴

There are presently 21 universities in South African.³⁵ Universities were established much earlier in South Africa than in Nigeria, or indeed anywhere else in Africa, and their development was shaped by the apartheid systems and, despite significant recent reforms, still reflects some of the influences of that system.

Many of the older universities were initially established in the nineteenth century as colleges—i.e., the University of Cape Town was founded as the South African College in 1929, the University of the Orange Free State as the Grey College and the Rhodes University as St. Andrews College both in 1855, and the University of Stellenbosch as the Stellenbosch Gymnasium in 1866. These colleges were initially designed to provide secondary education. There were only two universities established as such during the

³³ For agriculture the student-teacher ratios increased from 12 students in 1987 to 13 in 1994. For veterinary medicine the ratio increased from five to seven, and for the sciences in general from nine to 15 during the same period.

³⁴ This section draws heavily from Muller (1991), Van Rooyen, Barnard, and van Zyl (1996), and ACU (1997).

³⁵ The higher-education system in Nigeria also consists of a number of “technikons” (providing vocational education and training), agricultural colleges (13 in total), colleges of education, and various other colleges.

Table A.1 Directory of subjects offered in the agricultural sciences in Nigeria

	1965 ^a		1983 ^b		1993 ^c	
	Only BSc	BSc and postgraduate	Only BSc	BSc and postgraduate	Only BSc	BSc and postgraduate
	<i>(number of universities)</i>					
Agricultural economics/management	2	1	5	5	9	8
Agricultural engineering/ technology/mechanization	3	--	4	5	7	8
Agricultural extension	--	--	--	--	7	6 (1)
Agriculture (general)	3	1	7	6	10	1
Agronomy	--	--	1	5	3	2
Animal science/production	1	--	6	5	9	10
Agricultural education	--	--	--	--	1	--
Crop science/production	--	--	4	5	8	7
Environmental sciences	--	--	--	--	2	1
Fisheries/fisheries technology	--	--	3	2 (4)	8	2 (2)
Food science/technology	--	--	4	3 (1)	8	5 (1)
Forestry and wood science	1	--	3	2 (1)	8	2
Land economics	1	--	--	--	--	--
Natural resources	--	--	--	--	--	--
Plant science	-- ^d	--	1	5 (1)	1	2 (2)
Soil science	4	--	3	5	5	6
Veterinary medicine and science	3	--	2	3	3	3
Water resources	--	--	--	--	2	1
Wildlife management	--	--	1	1	6	1

Sources: ACU (various issues).

Note: The numbers of universities where the designated field can *only* be taken at a postgraduate level are listed in brackets.

^a Nigeria had five universities in 1965.

^b Information was available for 17 of the 22 Nigerian universities with faculties of agriculture or agricultural related sciences. The other five universities were established in 1983 and no information on subjects offered was available yet. In total the Commonwealth Universities Yearbook listed 24 universities.

^c Information was available for 22 of the 28 Nigerian universities with faculties of agriculture and agricultural-sciences (also see Appendix Table A.1). In total Nigeria has 37 universities.

^d In soil science.

1800s, the University of Witwatersrand and Potchefstroom University. These four colleges and the two universities were developed as a system of educational institutions, linked to the University of London and designed to prepare students for examinations from London. In 1873, the University of the Cape of Good Hope was founded along the organizational and procedural lines of the University of London. The colleges continued to only offer tuition, although the examinations were now conducted by the University of Cape of Good Hope, but still under the ultimate auspices of the University of London.

During the period 1916 to 1952, the four founding colleges were upgraded to independent, degree-granting universities (except for the University College Fort Hare which was established in 1916 and gained its organizational independence in 1970). In 1952, South Africa had nine universities, of which eight effectively enrolled only white students,³⁶ and one university (i.e., the University of South Africa) was established as a distance learning institution serving all students.³⁷ The University College of Fort Hare was the country's only university admitting only black students. This practice continued to 1980. Among the older eight "white universities" (established prior to 1960), half the institutions offered instruction in English, the other half in Afrikaans. A further four university colleges were established during the early 1960s, two for Africans, one for Coloreds, and one for Indians. These four universities as well as the University College of Fort Hare, became fully fledged universities in 1970 and 1971. When some of the "homelands"—the so-called TBVC States—became independent during the 1970s and 1980s, three new universities were also established in these states.

Although a quota system for the enrollment of students of specific races at universities was introduced in university legislation in the early 1980s, it was never enforced, and the sections dealing with this system was subsequently scrapped from the law book a few years later. Since 1980, about 20 percent of all non-white students were enrolled in the so-called historically white universities. This percentage excludes the University of South Africa.

The university staff and student population still reflects the effects of the apartheid period and are the various institutions are still referred to as historically black or historically white universities. Ethnic patterns of student enrollments among the universities, while slowly changing, still reflects the effects of the apartheid regime. In 1991 the numbers per 1,000 of the respective population groups studying at South African

³⁶ Although some of these universities were formally open to all students, they only admitted a very small number of black students.

³⁷ The University of South Africa, together with Vista University still provide distance learning opportunities (i.e., off-campus instruction, mainly by correspondence). In fact, in 1995 around 35-40 percent of all the students enrolled at these two universities took distance learning courses.

universities were as follows: Whites 31.2, Indians 21.3, Colored 5.9, and Blacks (Africans) 5.4.

Reflecting the pattern found elsewhere in Africa, South African universities experienced a decline in real public funding per full-time equivalent student since the mid-1980s. These funding trends for tertiary institutions coincided with a substantial increase in the number of secondary school graduates seeking entry to the universities.

There are ten faculties of agriculture (of which two universities also have a faculty of veterinary sciences) among the 21 universities currently operating in South Africa. The total number (and consequently the share) of postgraduate students in the faculties of agriculture increased substantially in the late 1980s. Between 1987 and 1991, the historically white universities granted 903 postgraduate degrees in agricultural sciences compared with only 56 degrees at the historically black universities (partly because many of the historically black universities are absent a postgraduate program).

Appendix B: Overview of African Faculties of Agriculture and Agricultural Related Sciences

Country	University ^a	Faculties: ^a			Training program: ^b		
		Agriculture	Veterinary Sciences	Other	BSc	MSc	PhD
Angola	Universidade Agostinho Neto (1962 ^c , 1968 ^d)	X	(in agriculture)		-	-	-
Benin	Université Nationale de Bénin (1962 ^c , 1970 ^d)	X (1970)			X	X	-
Botswana	University of Botswana (1976 ^{de} , 1982 ^d)	X			X	-	-
Burkina Faso	Université de Ouagadougou (1965 ^c , 1974 ^d)	X (1973)			X	X	X
Burundi	Université du Burundi (1960)	X			X	X	-
Cameroon	Université de Dschang (1977 ^c , 1993 ^d)	X			-	-	-
	Université de Buéa (1977 ^c , 1993 ^d)	X	(in agriculture)		-	-	-
	Université de Douala (1977 ^c , 1993 ^d)			X (fisheries)	-	-	-
	Université de Ngaoundéré (1982 ^c , 1993 ^d)		X		-	-	-
Cape Verde	(none)	-	-	-	-	-	-
Central African Republic	Université de Bangui (1969)	X (1970)			X	-	-
Chad	Université de Njaména (1971)	X			-	-	-
Comoros	(none)	-	-	-	-	-	-
Congo	Université Marien Ngouabi (1959 ^c , 1971 ^d)	-	-	-	-	-	-
Côte d'Ivoire	Ecole Nationale Supérieure Agronomique (1965)	X			X	X	-
	Université Nationale de Côte d'Ivoire (1958 ^c , 1964 ^d)			X (environment)	X	X (?)	-
Djibouti	(none)	-	-	-	-	-	-
Eritrea	University of Asmara (1958, 1991 ^f)	X			X	-	-
Equatorial Guinea	(none)	-	-	-	-	-	-
Ethiopia	Alemaya University of Agriculture (1954 ^c , 1985 ^d)	X		X (forestry)	X	-	-
	Addis Ababa University (1950 ^c , 1961 ^d)	X (?)	X (1979)		X, X	-, X	-, -
Gabon	Université Omar Bongo (1970)			X (forestry)	X	- (?)	- (?)
Gambia	(none)	-	-	-	-	-	-
Ghana	University of Ghana (1948 ^c , 1961 ^d)	X (1951)			X	X	X
	University of Science and Technology (1951 ^c , 1961 ^d)	X (1961)		X (environment)	X	X	X
	University of Cape Coast (1962 ^c , 1971 ^d)	X (1975)			X	X	X

Country	University ^a	Faculties: ^a			Training program: ^b		
		Agriculture	Veterinary Sciences	Other	BSc	MSc	PhD
Guinea	(none)	-	-	-	-	-	-
Guinea Bissau	(none)	-	-	-	-	-	-
Kenya	University of Nairobi (1950 ^c , 1970 ^d)	X (1970)	X (1962)		X, X	X, X	X, X
	Egerton University (1939 ^c ?, 1987 ^d)	X			X	X	-
	Moi University (1984)	X		X (forestry and wildlife) X (environment)	X, X, X	X, X, X	- , -, -
Kenya (continued)	Jomo Kenyatta University of Agriculture and Technology (1972 ^c ?, 1985 ^d)	X (1981)			X	-	-
	University of Eastern Africa, Baraton (1980)	X			X	-	-
Lesotho	National University of Lesotho (1945 ^c , 1964 ^{de})	X			X	X	X
Liberia	University of Liberia (1851 ^c , 1951 ^d)	X (1956)		(forestry, in agriculture)	X	-	-
Madagascar	Université d'Antananarivo (1955 ^c , 1960 ^d)	X			X	X	X
Malawi	University of Malawi (1964)	X (1967)			X	X	X
Mali	Institut Polytechnique Rural de Katibogou (1965)	X (1965)			X	X	-
Mauritania	Institut Scientifique Supérieur (1986)	?					
Mauritius	University of Mauritius (1965)	X (1968)			X	X	X
Mozambique	Universidade Eduardo Mondlane Maputo (1962 ^c , 1968 ^d)	X		(forestry, in agriculture)	X	-	-
Namibia	University of Namibia (1992)	X (1995)			X	-	-
Niger	Université de Niamey (1971 ^c ?, 1973 ^d) (renamed Université Abdou Moumouni?)	X (1972/73)			X	X	-
Nigeria	University of Ibadan (1948 ^c , 1962 ^d)	X (1949)	X	(forestry, in agriculture)	X, X	X, X	X, X
	Ahmadu Bello University (1962)	X (1962)	X (1964)		X, X	X, X	X, X
	University of Nigeria (1960)	X (1960)	X (1962)		X, X	X, X	X, X
	Obafemi Awolowo University (1961)	X (1962)			X	X	X (?)
	University of Benin (1970 ^c , 1972 ^d)	X			X	X (?)	X (?)
	Usmanu Danfodiyo University (1975)	X (1980)	X		X, X (?)	X (?), - (?)	X (?), - (?)
	University of Maiduguri (1975)	X (1977)	X (1981)		X, X	X, X	X (?), X (?)
	University of Calabar (1975)	X			X	-	-
	University of Ilorin (1975 ^c , 1977 ^d)	X			X	X	X (?)
	Federal University of Technology, Akure (1981)	X			X	- (?)	- (?)

Country	University ^a	Faculties: ^a			Training program: ^b		
		Agriculture	Veterinary Sciences	Other	BSc	MSc	PhD
Nigeria (<i>continued</i>)	Federal University of Technology, Minna (1983)	X			X	X	- (?)
	Federal University of Technology, Owerri (1980)	X			X	- (?)	- (?)
	Federal University of Technology, Yola (1981)	X		X (environment)	X	-	-
	University of Agriculture, Abeokuta (1983)	X (1988)		X (fisheries, forestry and environment)	X, X	-, -	-, -
	University of Agriculture, Makurdi (1980)	X (1988)			X	-	-
	University of Agriculture, Umudike (1992)	X (1992)			X	-	-
	Edo State University (1981)	X (1982)			X	-	-
	Ogun State University (1982)	X			X	-	-
	Rivers State University of Science and Technology (1977 ^c , 1980 ^d)	X (1979)			X	X	X (?)
	Abubakar Tafawa Balewa University of Technology (1980)	X			X	-	-
	Enugu State University of Technology (1991)	X			X	X	X
	Abia State University (1981)	X	(in agriculture)		X	-	-
	Ladoke Akintola University of Technology (1990)	X (1990)			X	-	-
	University of Uyo (1983)	X			X	- (?)	- (?)
	University of Jos (1971 ^c , 1975 ^d)			X (environment)	X	X	X
	University of Lagos (1962)			X (environment)	X	- (?)	- (?)
	Delta State University (1992)	X			X	- (?)	- (?)
	Imo State University (1992)	X			X	- (?)	- (?)
Reunion	(none)	-	-	-	-	-	-
Rwanda	Université Nationale de Rwanda (1963)	X (1979)			X	X	-
Sao Tome & Principe	(none)	-	-	-	-	-	-
Senegal	Ecole Nationale Supérieure d'Agriculture (1980?)	X (1980)			X	X (?)	- (?)
	Université Cheikh Anta Diop (1918 ^c , 1957 ^d)		X		X	X (?)	X (?)
Seychelles	(none)	-	-	-	-	-	-
Sierra Leone	University of Sierra Leone, Njala University College (1964 ^c , 1967 ^d)	X (1964)		X (environment)	X, X	X, X	X, X
Somalia	Somalia National University (1969)	X	X		X, ?	?, ?	-, -
South Africa	University of Stellenbosch (1866 ^c , 1918 ^d)	X		X (forestry)	X, X	X, X	X, X

Country	University ^a	Faculties: ^a			Training program: ^b		
		Agriculture	Veterinary Sciences	Other	BSc	MSc	PhD
	University of Pretoria (1908 ^c , 1930 ^d)	X	X		X, X	X, X	X, X
	University of Natal (1909 ^c , 1949 ^d)	X			X	X	X
	University of the North (1959 ^c , 1970 ^d)	X			X	-	-
	University of Orange Free State (1855 ^c , 1950 ^d)	X			X	X	X
	Medical University of South Africa (1976)	X	X		X, X	-	-
	University of Fort Hare (1916 ^c , 1970 ^d)	X			X	X	X
	University of Bophuthatswana (1979)	X			X	-	-
	University of Zululand (1960)	X			X	-	-
	University of Venda (1983)	X		X (environment) (forestry, in agriculture)	X, X	- (?), - (?)	- (?), - (?)
Sudan	University of Khartoum (1900 ^c , 1956 ^d)	X (1938)	X (1938)	X (environment)	X, X, X	X, X, X	X, X, -
	University of Juba (1975)			X (environment)	X	X	X
	University of Gezira (1975)	X (1978)			X	X	X
	Red Sea University (1994)			X (fisheries)	X	-	-
	Sudan University for Science and Technology (1950 ^c , 1975 ^d)	X		(forestry, in agriculture)	X	X (?)	-
	Bahr-Elghazal University (1991)	X	X	(environment., in agriculture)	(?)	(?)	(?)
	Dongola University (19??)	X			(?)	(?)	(?)
	El-Gadarif University (19??)	X		(natural resources, in agriculture)	(?)	(?)	(?)
Sudan (continued)	Upper Nile University (19??)			X	(?)	(?)	(?)
Swaziland	University of Swaziland (1976 ^{ce} , 1982 ^d)	X			X	X	-
Tanzania	Soikone University of Agriculture (1984)	X	X	X (forestry)	X, X, X	X, X, X	X, X, X
Togo	Université du Bénin (1962 ^c , 1970 ^d)	X (1972)			X	X	-
Uganda	Makerere University (1922 ^c , 1949 ^c , 1970 ^d)	X (1924)	X	X (environment) (forestry, in agriculture)	X, X, -	X, X, X	X, X, -
Zaire	Université de Lumbubashi (1955)		X (1958)		X	X	X (?)
	Université Nationale de Zaïre	X			X	X	X
Zambia	University of Zambia (1965)	X (1971)	X		X, X	X, X	- (?), - (?)
Zimbabwe	University of Zimbabwe (1953 ^c , 1971 ^d)	X (1980)	X (1982)		X, X	X, X	X, X

Country	University ^a	Faculties: ^a			Training program: ^b		
		Agriculture	Veterinary Sciences	Other	BSc	MSc	PhD
	Africa University (1992)	X		(natural resources, in agriculture)	X	X	-

Source: IAU (1996), UNESCO (1996), FAO (1996a and b), Commonwealth (1994), and some other (uncited) country-specific references.

Note: Only universities with agricultural or related faculties are listed in the table. Other higher-education institutions in general provide training up to diploma or certificate level are, therefore, not included in this table. "Faculties" also include other university entities that provide training in agricultural or related sciences (e.g., agricultural colleges, institutes).

^b Establishment date of university or faculty, if available, is given withing brackets.

^b For francophone countries the degree status is determined on the following basis: three -four years' full-time university (BSc), five-six years (MSc), and more than six years plus doctorate thesis (PhD).

^c Year founded as a college (anglophone countries) or "centre d'enseignement" (francophone countries), or other non-university institutional setting.

^d Year university status gained.

^e Established in 1964 as the University of Basutoland (Lesotho), Bechuanaland (Botswana) and Swaziland. In 1976 the university was divided into a national university in Lesotho (i.e., the University of Lesotho) and the University of Botswana and Swaziland was established (with a campus in Swaziland being established in 1976). The two campuses became independent (national) universities in 1982.

^f Re-established.

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