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Strengthening Research and Training in Sub-Saharan African Universities

Abstract

Universities represent one of the most important kinds of scientific institutions in Africa. In addition to offering advanced scientific training, they account for a significant proportion of national research and development activities. But African countries are increasingly unable to support their systems of innovation, including universities, and they are falling behind other developing countries in the production of science. This paper examines the establishment of higher education in Africa, trends in educational expansion, the high costs of scientific training, and the politicization of universities. Strategies for strengthening postgraduate training and research capacities in African universities must take into account the inter-relationships between postgraduate and undergraduate education and the poor quality of science education from primary to university levels. Attention is drawn to the need for diversification of university systems, reduced reliance on government funding, and better integration of universities into national research and development efforts.

Résumé

Les universités figurent au premier rang des établissements scientifiques en Afrique. En plus de dispenser une formation scientifique avancée, elles effectuent un volume important d'activités de recherche-développement. Mais les pays africains ont de plus en plus de mal à épauler leurs systèmes d'innovation, notamment les universités, et ils traînent derrière d'autres pays en développement au chapitre de la production scientifique. Cet article analyse l'implantation de l'enseignement supérieur en Afrique, les tendances en matière d'expansion, les coûts élevés de la formation scientifique et la politisation des universités. Les stratégies visant à renforcer le potentiel de formation et de recherche au niveau des 2^e/3^e cycles et de 1^{er} cycle et de la piètre qualité de l'enseignement des sciences depuis le primaire jusqu'à l'université. L'auteur fait état du besoin de diversifier les systèmes universitaires, de moins compter

sur les fonds gouvernementaux et de mieux intégrer les universités dans les activités nationales de recherche-développement.

In a recent paper, we compared the growth of scientific research in Sub-Saharan African and Asian countries between 1977 and 1987 (Eisemon & Davis, 1992). Comparisons of national research expenditures as well as the production of mainstream research in agriculture, health sciences, engineering, and other fields indicated that most Asian countries spend a much higher proportion of GNP for research than African countries, many of which have been unable to sustain the expenditure levels of the 1970s. While the scientific output of most Asian countries increased faster than the growth of world mainstream science, often spectacularly, African science grew more slowly than world science. The relative, and in many countries, absolute decline of research activity is particularly apparent in the university sector, one of the fastest growing science producing sectors in Africa in the 1970s (Davis, 1983). African universities account for a significant proportion of national research capacity in most countries, often employing between 20% to 30% of research scientists and engineers. Nevertheless, African university researchers typically receive a small share of national research and development funds, reflecting the general inability of many countries to support both research and training activities.

This paper examines strategies for strengthening the research capacities of African universities, especially their important role in postgraduate training in scientific and professional fields. However, such strategies must take account of the broader roles and functions of African universities as well as their development, governance, organization, financing, and articulation with other kinds of scientific and educational institutions. We consider that reforms should be guided by three inter-related objectives which address the need to: (1) improve the quality of scientific and technological training in African universities and to better integrate university research into national research efforts; (2) strengthen the training capacity of African universities while simultaneously lowering the unit costs of producing graduates; and (3) increase the responsiveness of universities to national scientific and educational priorities while insulating universities from political interference.

African countries and their infrastructures for scientific training and research vary enormously, making it difficult to offer generalizations about them. Some countries, like Nigeria and Kenya, have university systems whose development began in the colonial period, a large network of government and parastatal scientific institutions that carry out research and development activities mainly in agriculture and other applied scientific fields, and regional scientific institutions engaged in research and advanced scientific training supported by consortia of foreign donors. On the other hand, many countries have only one university, rely on foreign countries for most undergraduate as well as postgraduate scientific training, and have few government scientific institutions.

Foundations of University and Scientific Development

The problems of African higher education are increasingly seen by African governments and foreign donors to require attention, and have a very long history that is important to review. Several characteristics of university and scientific development in Africa set its experience with institutions for modern scientific training and research apart from that which exists in Asia and Latin America.

In most African countries, providing higher education is the responsibility of governments, while responsibility for applied scientific research has been shared by government, the private sector, and more recently by foreign donors. Voluntary groups, mainly missionaries and sometimes local communities, played an important role in educational expansion throughout the colonial period. However, they usually did not have any responsibility for higher education whose development was closely monitored and financed by the state in order to prevent universities from becoming centres of nationalist and ethnic agitation as was the case in India (Basu, 1974). For most of the colonial period, universities in metropolitan countries and the United States provided the only opportunities for Africans to acquire higher education.

When the first generation of modern African universities was established after the end of the Second World War, their missions, programs, staffing, and enrollments were carefully articulated with plans for gradual indigenization of the administrative and professional ranks of the colonial civil service. This had multiple and lasting consequences; one consequence was that most direct costs of higher education were borne and continue to be assumed by national governments. That was the mechanism through which colonial authorities ensured the political quietude of university students (Southall, 1974), and through which independent governments have attempted, with increasingly less success, to create a trans-tribal educated elite loyal to the state's ideology of nation building and modernization.

Government subsidy of higher education in most African countries is seen as necessary for political development, for national integration, and for correcting ethnic and regional inequalities in educational attainment. This has largely precluded the involvement of local communities and voluntary organizations in the financing of higher education, forcing governments to reduce expenditures by shifting a higher proportion of direct costs onto students whose political loyalties have been purchased by a tradition connecting the colonial and independence periods.

A second, related consequence of the way in which African universities developed is the reliance on low volume, high unit-cost educational models, particularly for undergraduate studies. Influential metropolitan historians of higher education, like Ashby (1966), have represented this as a response to fears expressed by the incipient African intelligentsia that colonial authorities

might foist "adapted" models of higher education on Africa as they had done with primary education. Nothing less than what Ashby described as the "gold standard" of metropolitan higher education would suffice. Whatever the truth of the matter – Africans had little direct influence on the development of higher or other levels of education during the colonial period – as long as metropolitan and western countries were the source of most opportunities for higher education, and especially for postgraduate education, secondary education as well as the undergraduate programs of African colleges and universities had to conform to the requirements of these universities, which often had affiliating relationships to African institutions. Although almost all African universities are now autonomous, continued reliance on foreign training limits the scope for program innovation while, at the same time, paucity of resources makes maintenance of metropolitan standards difficult.

The development of higher education in late colonial Africa was prompted by concerns about the welfare and development of dependent peoples which the Atlantic Charter and the United Nations brought into focus (Davis, 1982). After independence, governments placed importance on "Africanizing" the civil service as rapidly as university expansion and foreign training would permit. Increased demands for teachers at the secondary school level, where a large number of expatriates continued to be employed, usually sustained the expansion of undergraduate programs making teacher education more central to higher education as opportunities in governmental administrative services diminished.

The establishment of scientific institutions usually preceded the establishment of universities in Africa, in many countries by several decades. In most African colonies, little attention was paid to articulating university training and research with the work of public or private research and development organizations in sectors of economic importance. In neither French nor in British Africa was the growth of higher education institutions coordinated with the development and indigenization of African scientific institutions during the colonial period. In fact, postgraduate training was not envisaged as a mission of the universities created shortly before and immediately after independence. Foreign donors took responsibility for most staff development. The need for postgraduate programs became apparent only when African governments realized that without the capacity to train their own staff, the direction and pace of university expansion – and, more importantly, the pace of "Africanization" of all public institutions – would remain outside their control. Postgraduate training programs were hurriedly introduced beginning in the late 1960s and early 1970s.

After independence, governments in anglophone Africa assumed responsibility for staffing and maintaining national scientific institutions and services, including many commodity research institutes which were either

absorbed into the government sector or became dependent on government financing and subordinate to national scientific and educational planning. The network of interterritorial colonial scientific institutions and services, and the regional scientific councils that co-ordinated their activities, gradually disappeared due to nationalist pressures which also undermined regional models of higher education like the University of East Africa (Eisemon, 1984). Foreign donors stepped in to establish new regional scientific institutions in the 1960s to carry out research mainly in agriculture and other applied scientific fields. Most eventually acquired important training functions. Although the activities of these regional institutions were to be linked to those of national scientific institutions, as was the case in the colonial period, institutions like the International Institute for Tropical Agriculture have become responsible for field testing new varieties at experiment stations throughout the subregion (Eisemon, Davis, & Rathgeber, 1985). They have governing structures designed to insulate them from scientific nationalism and ensure attention to research related to the basic food security needs of the poorest sector of rural populations which were largely neglected in the colonial period in British Africa (Eisemon, 1984). Such institutions account for an increasingly large share of the mainstream scientific output of African countries (Davis, 1983a). They are Africa's points of contact with the international scientific system in research and advanced scientific training, but their connections to national scientific institutions, especially with African universities, have always been more fragile (Eisemon, 1979, 1980; Davis, 1982) and weakened in recent years by the declining national research efforts of many countries in the region (Eisemon & Davis, 1992).

In former French Africa, colonial scientific legacies dissolved more slowly chiefly because many African scientific institutions were staffed, financed, governed, and their facilities even owned by the former metropolitan power for many years after independence. Scientific cooperation was considered to be part of a larger package of technical, financial, managerial, and military services rendered by the former metropole.

Trends and Predicaments

Patterns of university expansion

The largest university systems of Africa in the most populous countries are smaller than university systems in most mid-sized North American provinces and states. For example, Nigeria, which has the most universities (30) and had the highest postsecondary enrollment in Africa in 1988-89 (150,000), had about as many university students as anglophone and francophone universities in Quebec that year (UNESCO, 1988, pp. 3-206 to 3-220). In most other African countries, aggregate university enrollments are less than twenty thousand, about the size of private North American universities like McGill. In

their size and residential character, most African universities correspond more closely to American liberal arts colleges with the important difference that African universities typically offer a full range of academic and professional programs and often postgraduate as well as undergraduate studies.

In almost all African countries, opportunities for higher studies are allocated on the basis of a competitive secondary school leaving and/or university entrance examination administered by a government examining authority. Increasing numbers of qualified secondary school leavers are demanding access to higher studies, putting tremendous pressures on national university systems. In some francophone African countries with highly selective systems of secondary education, the more rigorous *baccalauréat* still entitles students to university admission though not necessarily to the program of their choice (Ransom, 1988). In several African countries, the development of a backlog of qualified candidates has created pressures leading to significant expansion of intake. In 1988, only about one-quarter of the 13,800 qualified 'A' level leavers were initially to be placed in Kenyan universities; a public debate persuaded the government to increase the intake to 7000 students (King, 1989).

African universities and colleges typically do not **independently** set their own entrance requirements, determine the level of intake, assign students to particular programs or permit students to select an academic program after an initial period of general studies. Nor do most African universities and colleges independently raise funds for expansion of facilities, program and staff development or for research, or receive funds for these purposes from foreign donors without prior approval of government ministries. The advice of university administrators in planning higher education may be solicited but patterns of university expansion reflect government policies which, in turn, are influenced by many factors: projected needs for highly skilled manpower, the growth of secondary schooling, the lending policies of international donors, the priorities of bilateral assistance agencies, and so forth. Generally, students have very limited choices in selecting fields of study; in countries like Ethiopia, no choice; they are assigned to programs depending on their secondary school examination results, with medicine admitting the best students.

Postsecondary enrollments in most African countries have increased enormously since independence. In the 1980s, overall growth in most countries has been less dramatic though still impressive. Nevertheless, certain African countries like Kenya appear to be on the verge of truly massive expansion of national higher education systems. The problem in those countries will be to develop and finance mass systems of higher education of acceptable quality and economic and social utility while also selectively supporting high quality postgraduate training and research capability.

The distribution of postsecondary enrollment varies widely throughout fields of study (UNESCO, 1988, pp. 3-206 to 3-220). For instance, the proportion of students in science and health-related fields in 1985 varied from

14% in Botswana to 40% in Madagascar, the majority of whom were studying medicine. In that year, most of the smaller African countries with more newly established universities usually had a higher proportion of students in the humanities and social sciences as in Burundi (40%) and Botswana (54%), although even in Nigeria a third (33%) of students were in these fields. Enrollments in engineering and agriculture were very low in most countries, for example 6% and 2%, respectively, in Côte d'Ivoire. Another trend in most countries was the relatively high proportion of students in education: 70% in Lesotho, 61% in Malawi, 37% in Madagascar, 33% in Botswana, 27% in Côte d'Ivoire, and so on. In only a few countries like Nigeria was the proportion of students in education (15%) about the level that is typical in North American and European countries, indicating that the demand for teachers created by expansion of other levels of the education system, coupled with the need in many countries to replace significant numbers of expatriate secondary school teachers (World Bank, 1988, p. 172), continues to strongly influence university enrollments.

Education is also a leading field for postgraduate studies in many African countries (UNESCO, 1988, p. 3-263 to 3-272). Undergraduate secondary school teacher education programs are a relatively recent innovation. In several countries a high proportion of enrollment is in medicine and law. Postgraduate enrollments in fields like agriculture are a very small proportion of the total at this level: 5% in Senegal, for example.

A surprisingly large number of countries have a high proportion of university students in postgraduate programs. The proportion of postgraduate students is usually inversely related to the size of a country's university system, with some exceptions like Botswana. In Kenya, a country with a relatively large university system, 20% of all students are postgraduates. In four of the ten African countries for which recent enrollment information is available, the proportion of postgraduate students is 20% or higher. This is about twice the proportion of postgraduates in Canadian universities (UNESCO, 1988, p. 3-273).

The expansion of postgraduate programs is in part attributable to the transplantation of metropolitan models of training secondary school teachers and, in some countries, of training physicians as well. But in most African countries, the establishment of postgraduate programs also arises more generally from the need to Africanize universities and national scientific institutions to reduce reliance on expatriate staff and donor assistance for university development.

To reiterate, the university systems of most African countries have modestly expanded in the 1980s after growing very quickly during the preceding decade. However, a number of them may find themselves swept into

a second surge of growth that is driven by dramatically increased numbers of secondary school graduates who are qualified for university study. Expansion will place severe strains on university systems that are already struggling to fulfill their mission to educate. Similarly, expanded output of graduates could well strain the capacity of national economies to absorb increased highly trained manpower, even though processes of educational expansion in most African countries increasingly attempt to favour scientific and technical studies despite strong demand for places in law, arts, and related disciplines.

As increasing numbers of qualified secondary students seek admission to university, African countries will have to find ways to blend mass educational opportunity and elite postgraduate training and research capability. These two missions cannot readily be reconciled within individual institutional models that are replicated indiscriminately throughout a national educational system. They are best reconciled within well articulated, institutionally differentiated educational systems which are, in turn, integrated into national systems of production and innovation.

High costs and few ways to reduce them

The World Bank's recent policy study, *Education in Sub-Saharan Africa*, dramatizes the relatively high cost of higher education: "As a percentage of GNP per capita, [unit costs] are between six and seven times more in Sub-Saharan Africa than they are in Asia and nine times more than in Latin America" (World Bank, 1988, p. 75). Disaggregated data on recurrent costs suggest that half of public expenditures for higher education in Africa are allocated for teachers' salaries and benefits, and most of the remainder (37%) for student bursaries. The implication is that increasing Africanization of the academic staff will push teacher costs and, hence, unit costs, even higher. Donors will no doubt be solicited to maintain support for expatriates and perhaps also contribute salary support to selected African institutions of higher education, thereby lengthening periods of institutional development. Short term cost control imperatives have in fact decelerated the pace of Africanization in a cooperative project involving a Canadian and a Senegalese engineering school (Davis & Laberge, 1986).

Teachers' salaries, once pegged to the costs of employing expatriates, have been declining in relative terms in many countries. There are several impediments to reducing aggregate teacher costs in most African countries. The demand for university lecturers is still high and increasing, as we pointed out above. There is evidence of increasing underemployment and underutilization of university graduates in many African countries, and increasing apprehension about the ability of African economies to generate enough jobs for university graduates (Hughes, 1987; Ukaegbu, 1985; Court, 1990). However, there is little evidence of unemployment among postgraduates, especially in

scientific and technical fields. This is in part because of continuing employment opportunities in the university sector, and in part because of the Africanization of the senior ranks of the modern private sector in several African countries. University salaries and benefits are increasingly less competitive than those of many professional and managerial occupations in the private sector, and austerity programs have made the security of public sector employment a less attractive inducement. In fact, in an increasing number of African countries, the participation of university academics in private sector enterprises is almost as common as it is in Latin American countries. Academic employment is becoming a part-time job for full-time staff with all of the attendant difficulties for organizing academic programs (Eisemon, 1986).

With respect to student costs, concern has been expressed in many quarters about subsidies for students. No tuition fees are charged in most African countries and students are usually given allowances for housing and subsistence (World Bank, 1988, p. 76). This is sometimes viewed, quite correctly, as a public subsidy whose benefits in terms of increased lifetime earnings attributable to higher education are more likely to be captured by individuals than redistributed to the benefit of society. There is a large body of literature on comparative rates of return to investments in higher education which clearly establishes the higher private versus social rates of return to investments in higher education, particularly in Africa (Psacharopoulos & Woodhall, 1985, p. 56-57). Countries in which social and private returns are more closely aligned either a) have comprehensive and progressive systems of income taxation such as Sweden, New Zealand, and Norway, or b) charge students a high proportion of the costs of their university studies like the United States.

Not surprisingly, international lending institutions have come to see reduction of student subsidies as requiring more policy attention on the part of African countries. Student loan schemes "have been advocated for developing countries on the grounds of both equity and efficiency" based largely on what is represented to be the successful experience of developed countries and some developing countries, most of which are in Latin America and the Caribbean (Psacharopoulos & Woodhall, 1985, pp. 152 and 154). Claims that student loan schemes "can and do work" seldom make reference to African countries except as illustrations of what might have been if adverse political circumstances and lack of lending expertise had not intervened (Psacharopoulos & Woodhall, 1985, pp. 153 and 155). Changes in government, for instance, often prompt cancellations of loans, which ensure the temporary but nonetheless vital support of university students. This happened in Burundi in mid-1988 after a coup. Even military regimes seek legitimacy with such cost-cutting, cost-enhancing measures presumably designed to show the new government's commitment to equality of access to the privileges afforded the few fortunate to have an opportunity to attend university.

High student costs are exacerbated by the small size, low student-staff ratio, particularly in anglophone countries, and the large number of non-teaching staff of African establishments of higher education. These are due to several characteristics of African universities that cannot be easily manipulated for purposes of cost reduction. Most universities are residential institutions offering a full range of academic and professional programs with proportionately large postgraduate enrollments, and are important generators of unskilled as well as skilled employment. Analyses of higher education costs sometimes present residential institutions as a luxury for poor countries in Africa. That ignores the fact that African universities, unlike many of their counterparts in Latin America and some parts of Asia, developed *ab ovo* over a short period of time in or outside urban areas where there is intense competition for housing, and rudimentary or non-existent systems of public transportation. The costs of constructing and operating almost all major public and private institutions in Africa include significant expenditures for staff and student housing and staff transportation. However, African governments faced with severe cost pressures are being urged by international donors and local advisory groups alike to review existing budgetary commitments for student support and services.

It will be many years before most African countries develop private housing markets with a large stock of affordable rental housing, or before they have a large enough affluent urban population to support establishment of civic universities and "night schools." In some African cities like Nairobi, a number of such institutions have been established in recent years, offering studies in management, foreign languages, and computer applications, reflecting expansion of the private sector.

Student-staff ratios in African countries are "considered generous by comparison with industrial countries, where the student-staff ratio is more typically twice that in Africa" (World Bank, 1988, p. 76). About these matters as well, it is easier to identify problems than it is to find realistic solutions. Rapidly expanding university enrollments in some African countries have given rise to student-staff ratios more in line with those in industrial countries. In Kenya, for example, the faculty-student ratio increased from 1:8.5 in 1985-86 to 1:14 in 1988-89 (King, 1989, Table 7). More fundamentally, staff needs are determined by enrollment, teaching facilities, configurations of training, methods of assessment, workload formulations, and other factors. Simply increasing enrollment to boost the student-staff ratio does not necessarily increase the internal efficiency of universities unless residential and instructional facilities can accommodate them, and repetition rates are not greatly increased as a result. Radical measures, like those taken in Kenya in 1987 to double university intake, implemented by reorganizing the academic year into shifts while reducing student-staff ratios, produce massive disruption in instructional programs in institutions whose facilities and programs were not designed for mass undergraduate education. Such measures are especially

damaging to postgraduate training and staff research, much of which is carried out during what are designated as vacation periods, using laboratory, library, and other facilities that must also be used for undergraduate instruction.

The ratio of non-teaching staff to teaching staff is also considered generous: 14 to 1 in the case of Ghana (World Bank, 1988, p. 77). The legions of non-teaching staff encountered in most African universities, an extravagance from the point of view of many policy analysts in developed countries, exist at least in part because of the lower productivity of such staff in African countries.

Declining quality of education at lower levels and deterioration of the teaching environment within African universities are increasing the repetition rates of students. At the University of Burundi a majority of first year students are reported to fail the end-of-year examinations (Ministry of National Education, personal communication, 1987). At the University Marien Ngouavi in the Congo, repetition rates increased from 30% to 40% in the 1980s. This increase is attributed to declining quality of primary and secondary education as well as to the diminishing employment prospects for graduates. Countries like Kenya, which are moving toward mass higher education, can expect fairly substantial rises in failure and repetition rates as institutions attempt to cope with vastly overcrowded teaching situations. At Kenyatta University, the proportion of first-year students failing or repeating increased by 57% after the double intake of 1987 (King, 1989).

Rapid increases in student numbers also exacerbate the problem of faculty shortages. In June 1987, over one-tenth of the faculty positions at the University of Nairobi and one-half of the positions at Moi University were unfilled (King, 1989). Inevitably, education declines in quality as in the circumstances at Kenyatta University described by King:

There have been no tutorials since the 1987-88 academic year, despite a dramatic increase in sizes of many classes. Some faculty members have been forced to repeat the same lecture to as many as eight groups because of a shortage of lecture theatres of adequate size. In other cases, students have had to sit outside the classroom and listen to their lectures through the windows. The capacity of the library is 1500 while the enrollment has exceeded 6500. Rooms in the halls of residence originally designed for two are being occupied by as many as six students. (King, 1989)

Although no comparative data are available on costs of postgraduate studies, it is not likely that Africa would suffer by comparison to many developed countries, given the high proportion of students in what are usually

low-cost fields (such as education) with high student-staff ratios and low-facilities requirements. In other fields, particularly in the natural, biological, agricultural, and engineering sciences, observers note that many basic requirements of postgraduate studies are almost entirely lacking in universities in some countries (e.g., Tipple & Tipple, 1983). Many university laboratories, for instance, cannot support undergraduate science instruction, much less provide what is needed for high quality postgraduate training and staff research.

Not only are essential facilities often lacking, the demands of undergraduate programs take precedence over postgraduate training to the detriment of the latter. Opportunities for postgraduate training are limited by the requirements of undergraduate programs which understandably have higher priority. At the University of Nairobi, for example, less than a third of candidates for Master's courses in 1987-88 could be enrolled because of the lack of instructional and research space (Republic of Kenya, 1988, p. 77). Nevertheless, universities in Kenya and elsewhere in Africa often depend on postgraduates to staff undergraduate courses. At Kenyatta University and the University of Nairobi, tutorial fellows (usually doctoral students) teach up to four undergraduate courses per term. This involves a substantial time commitment which is much higher than that normally permitted for postgraduate teaching and research assistants in major North American universities. Senior academic staff, even professors, often teach up to four courses as well, leaving little time for supervising postgraduate students. No information is available on the average length of time students take to complete Master's or doctoral degrees. Our impression, based on a close association with staff in various departments in both universities since 1978 is that the time needed to produce graduates is very long, particularly for doctoral students whose dissertations must be externally examined. A year or more may elapse between the time a dissertation is submitted and the time the examiner's report is received and an oral defence is convened.

Universities and the political system

African universities paradoxically are at the centre and periphery of the network of scientific institutions which governments support and of political systems, more generally. It will be recalled that universities were usually the last scientific institutions to be established by colonial authorities, and while the initial intention was to provide training to enable Africanization of scientific research institutes and services, they acquired a broader mandate during decolonization and the first years of independence. The education of an indigenous governing elite was perceived by colonial authorities to require a measure of autonomy for local universities, consistent with metropolitan traditions, to ensure maintenance of high academic standards (Ashby, 1966). After independence, university statutes were revised to ensure their subordination to the state in matters of governance (Eisemon, 1980), though most African

universities were not then autonomous institutions in the western sense even in the colonial period (Southall, 1974). Still, the statutes of most African universities do provide for a very large measure of academic self-governance in matters such as staffing, the design and administration of academic programs and assessment of student performance, and usually responsibility for the operation of university teaching, research, and residential facilities as well (Eisemon, 1980; Eisemon, 1982).

Universities have grown to become pivotal institutions in African scientific communities due to the concentration of research staff and research funding in these institutions, and their increasing importance as a locus for advanced scientific training. These roles were not central to African universities at the time they were established or immediately after independence when new university statutes were adopted that, in turn, have influenced the subsequent development of university systems. Moreover, the linkages between universities and the productive sectors of African economies that use scientists and scientific research have become much more complex. At independence, government accounted for almost all wage and salary employment. Today, the government share of modern employment is shrinking in most African countries, many of which, like Burundi and Guinea, lack a tradition of indigenous entrepreneurship and whose development policies for a long time discouraged growth of the private sector. The network of scientific institutions and services inherited from the colonial period has profoundly changed as well. More importance has been placed on research on new varieties of food crops and their promotion has become a mandate of extension services, for instance. Producer co-operatives and marketing boards have been established for small farmers in most African countries where formerly these existed only for cash crops like coffee and tea or for food, dairy products, meat, and plantation-produced staples in countries with large populations of European settlers. In the health domain, new networks of community health facilities and services have been established and the emphasis shifted to preventive as well as curative treatment. Apart from some capacity for processing primary commodities, chiefly minerals and cash crops, few African colonies had a manufacturing sector. Today, most countries have manufacturers of a variety of durables and consumer items, although factories frequently operate at low capacity.

In developed countries, universities are made responsive to various user groups in many ways. Universities, including many private universities, are publicly financed and accountable to elected legislatures for their operating budgets. In Africa, instructional and research programs are influenced by governments and foreign donors. The governing structures of African universities and the planning of higher education reflect governmental and donor concerns. In this sense, African universities are isolated institutions, insulated from the wider society despite the Africanization of academic staff and their subordination to the state.

The subordinate role of African universities is frequently contested by students. Somnolent during the colonial period, universities are centres or potential centres of unrest. Student disturbances prompt frequent closures of universities as in Uganda, Kenya, and Zimbabwe in 1989. Several thousand Kenyatta University students recently rioted when they learned from the *Voice of Kenya* that allowances were to be discontinued. African governments often respond forcefully. In 1978, units of the Nigerian army attacked students at the University of Ibadan and other universities (Eisemon, 1979). In 1982, many Kenyan students suspected of participation in an unsuccessful coup attempt were killed and others raped by loyalist troops (Eisemon, 1986). In spring 1989, an undetermined but large number of Ethiopian students were killed during another unsuccessful coup attempt; more had lost their lives as a result of government pogroms against intellectuals in the late 1970s.

Student allegations of corruption, abuse of power, and political illegitimacy, typically made in order to elicit mass support, are often well founded. But the proximate causes of student unrest are usually less compelling. Student unrest often begins with unattended-to complaints over seemingly trivial matters. An example is the "egg balls" (meat balls cooked in egg batter) riot in the dining halls attached to the student residences at the University of Nairobi in late 1989. Protesting students entered the streets adjacent to the University where cars were stoned, prompting response from the police and threatening closure of the university. Students felt that they were being cheated, that funds allocated for their boarding were being misused by operators of the University's catering facilities. Politicians swiftly condemned the students and the national newspapers presented the incident as another instance of "spoiled" behaviour on the part of a privileged group indifferent to its social responsibilities. The University's vice-chancellor, anxious to avoid escalation of the controversy, acted on the students' complaints. He personally supervised preparation of the students' "egg balls," cooking several himself. Yet the students continued to riot, prompting him to close the University.

There are many factors which contribute to the atmosphere of crisis or impending crisis on African campuses. They tend to politicize higher education in ways that result in frequent disruption of university programs and they tend to make implementation of cost containment measures difficult. First, in most countries, university students are treated by governments as an incipient elite. This is a recurrent theme in development rhetoric and in the pronouncements of university administrators (Van den Berghe, 1973), and it is confirmed not only in the generous privileges accorded students but also in the actions of governmental and political authorities. When serious crises occur, it is often not university administrators from whom student groups seek redress for their complaints; they negotiate directly with ministers and heads of state. That is not simply presumptuous behaviour.

Decisions about matters that most affect students – their scholarships, loans, fees, the condition and occupancy of residential facilities, the health care

they receive, the amount and quality of food served in students' hostels – are seldom made by university administrators. They are made at the highest levels of government and university administrators are frequently powerless to influence them. Likewise, the handling of student unrest is monitored at the highest levels. It is common for governments to close institutions without consulting university administrators or university senates (Eisemon, 1986). The impotence of university administrators is reinforced by the fact that in almost all African countries, they are appointees of the head of state and, thus, mere intermediaries for many purposes. The status of a university administrator is seldom enhanced by being the personal representative of the head of state in the event of a student confrontation with government.

Second, many African universities are located in or near capital cities where student protest cannot go unnoticed. A few rocks and police intervention are all that may be needed to transform an insignificant agitation into a major political crisis ending in serious violence and university closure. The outcomes almost always seem disproportionate to the events that produce them. Nevertheless, student unrest does represent a real threat to the political capacity of regimes. If a government cannot elicit the loyalty, or at least acquiescence of the university students it patronizes so generously, what legitimacy does it possess? Moreover, while the issues prompting student unrest may not touch upon the concerns of the general population, their political behaviour is usually symptomatic of wider political malaise and responsive to economic conditions for which governments may be held responsible.

Third, the residential character of African universities, the lack of participation of students in university governance, and the organization of undergraduate education are important enabling factors in student unrest. Students are concentrated on university campuses where they may be easily mobilized by student groups or by outsiders as happened at the University of Nairobi during the 1982 coup attempt. University student associations are often proscribed as a penalty for student unrest and their activities very closely monitored and membership infiltrated, tactics which foster conspiracy and lack of student leadership. Finally, the preference in many African universities for annual examinations as opposed to continuous assessment leaves students, particularly those enrolled in arts and social science programs, a great deal of free time to engage in political activities.

Strengthening the Scientific and Technical Training and Research Capabilities of African Universities

In a provocative and recent essay on higher education, Heyneman and Etienne (1988, p. 9) ask: "How high a quality is a university [in developing countries] expected to reach?" They compare developing-country universities to hospitals, an appropriate analogy for many African countries whose public

health care systems are on the verge of collapse due to resource constraints that have eroded the quality of higher education as well. Heyneman and Etienne argue that "similar choices concerning breadth and depth come into play in designing a university," and that insofar as many of those in developing countries are concerned,

Financial resources . . . are rarely sufficient to cover the costs involved [and] even where resources are sufficient, developing countries are seldom able to support research functions over sufficient periods of time to make them effective. (Heyneman & Etienne, 1988, pp. 10 and 13)

There is much truth in this. African higher education is a rich source of examples of unsustainable development, particularly in regard to undergraduate and advanced scientific training. It is unlikely that many African governments will be able to increase the share of public resources devoted to higher education. At the same time, pressures for increased access to tertiary education can only increase.

Conventional remedies to these problems are easily described. Often conceived and implemented in connection with donor-imposed austerity programs, they include decreasing the unit costs of universities by rationalizing courses and programs, emphasizing scientific and technical courses of study over the arts and humanities, raising income through reduction of subsidized student services and increasing fees and service charges, laying off redundant teaching and support staff, inciting the universities to augment government funding with sales of services, and so forth.

Improving the quality of scientific and technical training

At the beginning of this paper we listed three objectives for the reform of African university systems that would contribute to their sustainability and help achieve these twin goals. These are: 1) to improve the quality of scientific and technological training and better integrate university activities into national research and development efforts; 2) to strengthen the training capacity of African universities while lowering the unit costs of producing graduates; and 3) to increase the responsiveness of universities to national scientific, technological, and educational priorities while insulating universities from political interference.

Evidence exists of the overall weakness of scientific and technical education in Africa. Data reported by the World Bank and assembled by the Educational Testing Service in the United States show that "the scores of African students on the verbal, quantitative, and analytic sections [of the *Graduate Record Examination*] are uniformly lower than those of Latin American, Asian, or Middle Eastern students" (World Bank, 1988, p. 74).

A plausible interpretation of the poor performance of African secondary and university students is that they are bright enough but poorly educated, notwithstanding the high costs of higher and secondary education in African countries. The low quality of scientific and technological training is the cumulative effect of deficiencies beginning at the primary level. Few African countries devote a significant proportion of primary school instruction to science and related subjects; in some, science is not taught and examined as a separate subject (Eisemon, 1989). And in contrast to most Asian countries, science at the upper primary and secondary levels is offered in a European language except in Tanzania and Ethiopia and a small number of other African countries (Eisemon, 1989). However, efforts are being made to change this situation, most notably in Nigeria where the national and several state secondary school science-teacher associations have been involved in preparing science curricula in vernacular languages for primary schools (Nigerian Science Teacher Association, personal communication, 1987). Achievement in science and mathematics in many African countries is very low (Savage, 1985; Eisemon, Schwille, & Prouty, 1989). The examinations themselves, which usually test students' recall skills (Heyneman, 1987; Eisemon, 1990), promote drill teaching of scientific information (Eisemon, 1988). Examination reform, such as that carried out in Kenya (Somerset, 1983), together with expansion of amount of science instruction and greater use of indigenous languages, should be part of any package of policies designed to improve the quality of primary school instruction.

At the secondary level, poor science instruction is particularly evident in laboratory subjects. In Kenya, a large number of secondary schools, mostly community financed secondary schools, do not have the laboratories needed to offer advanced instruction in chemistry and physics, though that does not deter many of them from offering instruction in these subjects (Maundu, 1986). However, providing better facilities is not a panacea for improvement as science teachers even in schools with good laboratory facilities do not always make much use of them (Namuddu, 1989; Maundu, 1986). Lack of spares for school laboratories, the poor training of science teachers in experimental methods, and practical examinations in science subjects designed to take account of interschool variations in laboratory facilities (and which, thus, discourage their construction, provision, maintenance, and use) contribute to the poor laboratory bench skills of entering university students, a frequent complaint of their lecturers (Eisemon, 1980, 1982; Davis & Laberge, 1986).

Of these problems, the lack of basic laboratory equipment has perhaps the most serious implications as it fosters a curator mentality among many teachers and headmasters. School laboratories, once furnished, may not be resupplied or are irregularly supplied with consumables that are often imported. Yet the increasing number of secondary schools and universities even

in small African countries should enable development of indigenous suppliers of many kinds of scientific equipment, especially manufacturers of laboratory glassware, suppliers of ordinary chemicals and laboratory specimens, producers of kits for experiments, and writers and publishers of course documents and textbooks. Public procurement policies should be used to nurture the development of local suppliers to the educational market in Africa.

Neither African governments nor international donors have given sufficient importance to developing inventiveness among science students or to fostering their curiosity. The intellectually deadening effects of examination preparation, uniform national curricula, and the fact that the shortage of educational opportunities ensures that students' interests do not have much to do with their course of study are partly responsible for this. There are few "enriched" science programs in African secondary schools, just better and worse schools and good and bad science teachers. Only a few countries, like Nigeria, Ghana, Zambia, and Kenya, have professional associations of science teachers and teacher educators. In these countries and some others like Tanzania, there are many innovative efforts to improve science education through newsletters for science teachers and science magazines for students, national science fairs, and science camps organized by university scientists for gifted students.

At the undergraduate level, African students normally take more coursework in their subject specializations than students in majors programs in many North American universities. Programs in science, engineering, agriculture, and other fields are frequently derivative of European models. Course content and sometimes even the texts used for instruction are similar, and expatriates are still responsible for much scientific instruction. Nevertheless, differences in the kind of laboratory training undergraduate students receive are just as important as at the secondary level. Lack of laboratory space, equipment and supplies, poorly qualified demonstrators and laboratory technicians, lack of student supervision due to large class sizes, and other factors have adverse implications for student practical work and, thus, for the quality of scientific training.

The weaknesses of scientific training in African universities are most apparent at the postgraduate level, a consequence of the combined effects of poor science instruction, poor laboratory skills, lack of necessary facilities and funding for student research, pressures for part-time postgraduate studies, and lack of supervision due to the competing needs of undergraduate programs and the evolution of academic work into part-time employment.

It may be sensible, as Heyneman suggests, for many African countries to develop more appropriate, less resource-intensive training models. The popularity of American course-based Master's programs in both francophone

and anglophone countries attests to concern for better relating program design to resource constraints. Course-based postgraduate programs make a virtue out of lack of practical necessities. They provide a low-cost model of research training which takes advantage of traditional strengths in examination.

These solutions to resource constraints are partial and *ad hoc*. More comprehensive solutions must be found if countries are to complete the process of Africanizing their universities and scientific institutions and build significant research capacity. There is much donor enthusiasm for concentrating advanced scientific training in regional centres of excellence (Ransom, 1988; IDRC, 1989). Regionalism in science and higher education has a long, controversial, and largely unsuccessful history in Africa (Eisemon, Davis, & Rathgeber, 1985; Davis, 1982). Regionalism in scientific training and research usually succeeds when donors pay for it. When African governments and their universities are asked to absorb the costs of regional responsibilities, or make contributions to the development of such capacities outside the country, these efforts fail. Whatever the attractions of a regional division of labour in advanced scientific training, few African universities have the excess instructional and research capacity that regionalism presupposes.

A more realistic approach than regionalism to strengthening advanced scientific training may be to adopt a practice of some Asian countries like India where universities affiliate government and even nongovernmental institutions for postgraduate studies (Eisemon, 1982). Indian universities make use of affiliated institutions' staff and research facilities. This reduces pressure on limited university resources and enables universities to provide higher quality training than they might otherwise be able to offer in specialties for which there is a demand for research scientists.

Another response to resource constraints is to form linkages with foreign universities so that responsibilities for postgraduate instruction and supervision are shared. This has a long history in Africa, and is done in an increasing number of African universities. Twinning of institutions of higher education is often considered by donors and clients alike to be a particularly effective device for technical assistance delivery (Cooper, 1984). However, cooperative arrangements have reciprocal impacts on participating institutions. The utility of a twinning relationship to a developed-country university is usually considered to be due more to the financial resources it generates than to scientific and technical payoffs (Davis & Laberge, 1987). Indeed, twinning arrangements in most fields of scientific, technical, and business education are frequently reported to experience difficulty recruiting faculty for long stays in the developing-country partner university. This is because academic researchers cannot afford the cost of long absences away from the knowledge frontier. In order to attract researchers in fast-moving areas of science and technology, institutional linkages must be designed around short, intense periods of

residence for researchers and graduate students in Africa, with many opportunities for African colleagues and their students to reciprocate. Such linkages will not be inexpensive, but they may be the only way to sustain capacity in advanced technological research in selected African universities.

Training technologists and engineers in Africa presents all of the problems of teaching scientific subjects plus some special difficulties. Lack of equipment for hands-on learning is a severe constraint. African engineering students frequently do not have the tacit technical skills that their homologues in developed countries have acquired in childhood from disassembling television sets and automobiles (Bessell, 1982). They therefore require more frequent formal opportunities to manipulate technical objects. Another problem is the lack of industrial experience among the engineering professoriate, and the lack of adjunct professors from industry. A third problem is the low frequency of opportunities for work-study experiences in industrial settings. Similarly, contact between business schools and technical schools in Africa is extremely rare. Engineering students and business students virtually never cross paths. These problems add up to indigenous engineers with little industrial exposure, strong inclinations toward theoretical and administrative work, and few opportunities to use their technical skills in an industrial environment.

The private sector in Africa makes very little contribution to national research efforts (Eisemon & Davis, 1992). Nor does the private sector or private philanthropy have an important role in African scientific development which it did not only in North America, but also in countries like India, and today in many of the newly industrializing countries of east and southeast Asia (Altbach *et al.*, 1989). With declining government investment in research and development activities and increasing reliance on foreign donors to support research (Eisemon, 1986; Heyneman, 1988; Eisemon & Davis 1992), ways must be found to broaden the base of national research funding. Increasing private sector involvement in financing higher education and research is becoming a concern of many countries (Ransom, 1988, p. 13).

Reducing costs and increasing output

A second objective of educational reform should be the reduction of unit costs in higher education and increased output of undergraduates as well as postgraduates. This task is difficult in public universities for the many reasons we have given above. Students' direct costs cannot be easily increased without effective and efficient systems for recovering loans, nor can more modest measures such as the use of selectivity criteria in awarding and continuing scholarships be introduced in the absence of "political will" weakened by student unrest (Ransom, 1988, p. 14). Even in developed countries, the principle of universality is so strongly associated with the notion of equity in higher education that increasing students' private investments imposes high and often unacceptable political costs.

Reduction of operating costs, the largest component of which is teachers' salaries and benefits, is even more difficult to accomplish without exacerbating the qualitative deterioration of higher education. That is also the problem with increased output strategies that are more appropriate for primary schools, such as double intakes, lengthening the academic year, and increasing the number of teaching hours. Of course, if African universities abandoned postgraduate training, leaving it to foreign universities as was true of higher education during most of the colonial period, then there would be more scope for low-cost, mass models of public higher education. This, however, would violate cherished notions of self-reliance which are prudent to maintain in an aid-policy environment characterized by fluctuation and much uncertainty.

Some increase in the output of postgraduate students can be obtained through involving national and regional scientific institutions in postgraduate training as well as through program integration. In most African universities, there is no overlap in the courses taken by undergraduate and postgraduate students, or sometimes between Master's and doctoral courses. Integration of coursework and collaboration with other scientific institutions can free some instructional resources for student research and supervision. Nevertheless, more radical initiatives are required.

We have drawn attention to the high postgraduate enrollments in professional fields like education and medicine in several countries. Postgraduate medical instruction, in specialties like community and internal medicine, is carried out for the most part in teaching hospitals with students whose undergraduate programs have emphasized studies in biology and other basic sciences (Rathgeber, 1982). The role of the basic sciences in medical education is controversial in developed countries. It is unclear how such instruction affects development of clinical problem solving skills (Patel, Evans, & Groen, 1989) and whether, in fact, a "problem-based" undergraduate program might be as effective (Schmidt, 1987). There are an increasing number of experiments with problem based undergraduate programs in community medicine in Egypt and other developing countries (Schmidt & DeVolder, 1984; de Grave, Moust, & Schmidt, 1985) that may have applicability in Sub-Saharan Africa for lowering the costs without affecting the quality of medical education (Schmidt, Dauphinee, & Patel, 1987). This would facilitate expansion of postgraduate programs in other scientific fields.

In education, high postgraduate enrollments are an outcome of the adoption of European models of secondary school teacher training which have very serious implications for the utilization of limited university facilities and resources. In many countries, teachers have more training in their teaching subjects than those qualified with an undergraduate education degree in either Canada or the United States which, of course, is not a bad thing given the low

quality of North American secondary education, particularly in mathematics and science. Yet the advantages of better teacher training that result from offering education as a postgraduate diploma are offset by the poor instructional resources of secondary schools and other consequences of educational school expansion. Many African countries like Kenya and Nigeria now offer secondary school teacher training at the undergraduate level, a practice that might be more widely emulated. A prerequisite, though, is reform of secondary education, shortening its length, revising its content to incorporate vocational as well as academic studies, along the lines of schools in North American countries. An important disadvantage is that graduates no longer qualify for admission to undergraduate programs in universities in metropolitan countries without additional pre-university studies. Moreover, the added costs of a mass rather than an elite model of secondary education, and resulting demands for access to higher education, are likely to be substantial.

New educational technologies, particularly for distance education, have been advocated for reducing higher education costs (World Bank, 1988, pp. 79 and 99). African experience with more modest innovations that rely on conventional techniques like correspondence and radio education (e.g., Nigeria's ill-fated open university experiment) is not predictive of future breakthroughs with low-cost, technologically sophisticated instructional approaches such as microcomputer based "intelligent tutoring" systems and interactive videotext, however promising these might be. On the other hand, African universities make little use of closed circuit television (Eshiwani, personal communication, 1988), which can optimize utilization of classrooms, or video instruction.

There is a great need to diversify kinds of higher education in African countries so that some institutions may focus on postgraduate training and research and others on undergraduate education. However, there is less scope for bringing about dramatic increases in internal efficiency in public universities than in private institutions that are growing in number, principally in eastern and southern Africa. Private higher education, properly supervised and accredited, can take some of the pressure off universities. It is an item of conventional wisdom that poor countries are too poor to support private higher education. Indeed, a high proportion of disposable income is already spent on education in rural households in countries where most public education is "free" or provided at nominal cost. The level of financial effort is comparable to what an American family might spend to send children to college (Eisemon & Nyamete, 1988; Eisemon & Schwille, 1990; Ongengo, 1990). As well, private universities, particularly religious universities like the Adventist University of Central Africa or the new Catholic university that is being established in Kenya, receive substantial direct and in kind financial support from external sources. Still, the capacity of Africans to finance education they perceive to be of benefit to their communities may be greatly underestimated. In the colonial

period and after independence, communities in most African countries have shown no lack of willingness to donate labour and funds for educational expansion.

The programs, operating costs, and methods of financing private institutions of higher education are poorly documented. The ones about which we have some information seem to be putting into practice what is recommended for lowering unit costs of higher education. Most charge tuition, and some such as the Adventist University of Central Africa in Rwanda, have work-study programs that have enabled expansion of university facilities and significantly reduced operating costs. Teachers' salaries are often much lower than salaries in public universities, teaching hours higher, but the institutions are well managed.

Privately financed educational expansion has important quality implications. In Nigeria, private universities were permitted in the early 1980s and abolished by 1984 because of unsatisfactory performance. Clearly, the emergence of a private higher education sector requires strict quality control procedures. Furthermore, some kinds of higher education services are more easily offered under private auspices than others. In some of the larger African countries, such as Nigeria, a significant proportion of students (about 8% in federal universities) are in sub-degree programs (World Bank, personal communication, 1989). It is likely that many of these courses could be offered privately. However, the requirement (to be implemented in coming years) that only sub-degree courses for which costs can be recovered remain within the university framework ensures that universities will divest themselves primarily of courses with low potential for privatization.

Privately financed educational expansion also has important equity implications. Equity concerns can be addressed through admissions quotas or manipulation of admissions requirements, providing scholarships or loans to needy students (with government funds or, as at the Adventist University of Central Africa, this may be made a responsibility of private universities), and through favourable matching grants to disadvantaged groups to facilitate establishment of institutions. Many African countries already employ one or more of these devices to redress inequalities in access to public secondary or higher education.

More responsive but more autonomous universities

University governing bodies usually do not have well-defined responsibilities vis-à-vis administrators, academic senates, or government. Moreover, their members are often high level servants, former politicians, and businessmen – typically, those with close relationship to the heads of state who appoint them and frequently serve as university chancellors. Senior academic

administrators are also appointed by heads of state and academic promotions are subject to government review. These patterns of subordination are reinforced by tight government control of university finance and budgeting and involvement in determining levels of student intake which affects the cost-structure of the universities.

It will not be possible for public universities to reduce costs and become more entrepreneurial unless they have more autonomy. University statutes require revisions that confer meaningful autonomy. This implies lay governance of the universities, i.e., selection of university chancellors by university councils, whose membership should include some individuals nominated by university senates, appointment of senior officers of the university by the councils; and university control of appointments boards. In addition, university governing bodies should have powers of approval of academic budgets and program enrollments. Restrictions on raising and disbursing funds should be liberalized and public universities given positive incentives in the form of matching grants to generate resources and effect cost-savings.

The formal structure for higher education planning in most African countries is easily described. There are planning offices in ministries of education and economic planning responsible for universities and sometimes planning units in the universities themselves. These are the units with which donor "missions" interact. As the World Bank frankly acknowledges, they frequently exist mainly to satisfy the data requirements of these agencies (World Bank, 1988, p. 86). In the East and West African countries in which we have worked, they seldom engage in policy analysis and even more rarely in policy research. Planning activities consist chiefly of projecting budgetary requirements from data on present practices. Information flows are one way. Educational planners use data supplied by universities on costs, enrollments, and other matters and receive requests for staff, facilities, equipment, and the like from university planners and administrators. Once funds have been allocated and intake levels determined, there is little follow-up aside, perhaps, from routine monitoring of the output of graduates.

Some African countries have developed fairly strong institutions for the management of university systems. The Nigerian Universities Commission and the new Commission on Higher Education (Kenya) are the best examples. In addition, many African countries have national science-policy units, a legacy of vigorous UNESCO promotion of science planning in the 1960s and 1970s (Davis, 1983b). Science-policy units were established to establish long-term national policy goals, co-ordinate research activities in the public and private sectors, direct national research funding, and identify shortages of scientific and technological manpower and propose strategies for remedying them. These ambitious intentions were seldom matched with the necessary resources and authority (see, for instance, Soumah, 1988). Most are now moribund.

Strengthened science policy and higher education planning structures could be useful in a role as intermediaries between universities, which are the core of the scientific community in most African countries, and government. Powerful policy and planning mechanisms are required which can advocate the needs of universities to government and protect their autonomy. These should be widely representative of users of university research and employers of graduates in the public and private sectors. That would help bring stakeholders into the policy process and mitigate some of the tension felt by university communities which harbor deep suspicions about the government reorientation of public higher education under fiscal restraint.

Conclusions

Postgraduate training and research capacities are weak as a result of many factors and circumstances which are legacies of the way African universities were conceived and which reflect the enormous demands placed upon them in the independence period. Significant efforts are being made to establish and expand postgraduate programs. These efforts are hampered by resource constraints and the competing needs of undergraduate programs.

The nascent university systems in African countries are not large enough to support universities whose primary mission is advanced scientific training and research. Little can be accomplished without increasing the number of institutions and undergraduate enrollments. Low-cost models of higher education must be developed for doing this through greater private philanthropy in the financing of higher education and more efficient use of instructional resources. Success is predicated not only on reducing the politicization of universities, but also on measures to improve the quality of scientific and technical education at all levels of the educational system.

Additional resources are needed, especially for laboratories and equipment, that governments will have difficulty in providing. African universities should broaden their sources of financing and foster closer relationships with users of scientific research and employers of graduates. That will require more representative governing structures and indirect relationships with government to protect university autonomy.

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