

5 The Nigerian Scientific Community: The Colossus with Feet of Clay

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The scientific future of African, particularly Black African, countries has become a highly debated issue of our time. Similar to the history of the Northern countries, economic and social development has long been acknowledged as going hand-in-hand with scientific development. That was the belief at the 1964 Lagos Conference. It is doubtful whether the relationship is as close in Africa as has been known at certain periods in the countries of the North. Nevertheless, the Nigerian scientific community, which emerged during the 1960s, had experienced an impressive growth during the 1970s (the years of the so-called oil boom). The oil boom years have been followed by a serious recession, developing into the present economic crisis in which the Nigerian scientific community is struggling to sustain its activities.

The emergence of scientific communities is often presented diachronically. This consists of following the history of a sector-based community defined by one or more sets of scientific themes, or a national community. Comparing the histories of several communities after that may prove to be difficult. In studying Nigeria, we adopted a dual approach: diachronic and synchronic. The synchronic approach was applied in the bibliometric study presented in this chapter. It involves characterizing the various countries of a group (in this case Africa) for a given period by applying the same analysis tools to all of them. This holds good for making comparisons.

Before presenting the results of this bibliometric study, this chapter begins with a brief account of the development of scientific institutions in the colonial and independence periods in Nigeria. It is followed by an analysis of the university system which has played a central role in the emergence of the Nigerian scientific community and continues to mark its own trajectory. The impact of the continuing economic crisis on the conditions under which research activities are carried out is also examined. In the concluding section, an attempt is made to characterize the specificities of the Nigerian scientific community. In that context, we think that there are 'types' of scientific communities (see also Chatelin and Arvanitis, 1988,

1991; Gaillard, 1994; Waast, 1995), each of which is defined by both its own particular history and scientific production mode (or 'styles').

The Development of Science in Nigeria: A Brief History¹

The development of science in colonial Nigeria illustrates some of the principal features of the British approach. In most cases, research was carried out by British scientists to find solutions to the problems that the British settlers had to face in the African environment. Thus, emphasis was put on research in tropical medicine and agriculture. In medicine, the main objective was to control diseases inhibiting the activities of the colonial settlers. In agriculture, research activities were aimed at improving land use and cultivation, and primarily at developing better cropping systems and higher yielding varieties of cash crops (Eisemon et al., 1985). The first research institutions for agriculture and medicine were founded in the first decades of this century. As far as agricultural research was concerned, a botanical station was established in Lagos in 1883 and a model farm was started at Moor Plantation in 1899 in Ibadan to propagate rubber trees and general agriculture (Evenson and Kislev, 1975). In 1910, the Department of Agriculture established its headquarters at Moor Plantation, where a chemistry laboratory was also constructed in 1926 (Idachaba, 1980).

Like in other British territories, the local colonial government in Nigeria was the main sponsor of research activities in the first part of this century. Initiatives were taken locally and very limited inter-territorial collaboration or coordination took place. Separate departments of agriculture, medicine, etc., were established and staffed with permanent research officers. With forty-nine British expatriates, the number of technical agricultural research staff present in Nigeria in 1938 positioned it in a leading position in Sub-Saharan Africa, after the Union of South Africa (Worthington, 1938). The British staff, although recruited from persons who already had university degrees and research training, often devoted their time to duties that could have been entrusted to auxiliary staff. This made Worthington argue in 1938 that one of the greatest needs of Africa was to train African natives as subordinate staff (*ibid.*). This lack was felt not only in agriculture, but in every other branch of research activity. Significant metropolitan funding for colonial research was not forthcoming until after the Second World War.

The institutionalization of a regional approach in British West Africa was then greatly influenced by the creation of coordinating and funding mechanisms, and by the organization of conferences at the metropolitan level. Previous colonial experiences called for better inter-colonial coordination of research activities as well as better coordination with metropolitan scientific institutions (Forman, 1940). The first British Commonwealth scientific conference was held in 1938.² A colonial research committee was

established in 1942 to advise the Secretary of State for the Colonies. This development was instrumental in the establishment of the West African Research Organization (WACRO). This was a regional network of research institutions intended to cover the four British colonies in West Africa: Nigeria, Ghana, Sierra Leone and Gambia. Two of these institutes had their headquarters in Nigeria: the West African Institute for Oil-palm Research (WAIFOR) and the West African Institute for Trypanosomiasis Research (WAITR). WACRO also included: the West African Rice Research Station (WARRS), the West African Maize Research Unit (WAMRU), the West African Cocoa Research Institute (WACRI), the West African Institute for Social and Economic Research (WAISER) and the West African Council for Medical Research (WACMR). Each institute was required to set up its own research stations. In 1957, Nigeria had fifty-seven scientists in seven institutions, while the West African inter-territorial S&T services had seventy scientists in nine institutions (Worthington, 1957). WACRO was dissolved in 1962, two years after Nigeria became independent.

The structure of the institutions provides a simplified but revealing picture of the role ascribed to research. WACRO's organization chart clearly expressed the colonial attitude, with priority given to a number of crops, primarily export crops: rice, maize, palm oil, cocoa. Agricultural scientific development in Nigeria, like all the research in the other countries of Africa, should be recognized as having begun on this basis (see Bonneuil, 1991). The emphasis on commodities in agriculture favoured the adoption of a single-product, problem-oriented approach well suited to large scale producers. This led to the emergence of a dual agricultural economy: a plantation economy³ serviced by a network of scientific institutions and an African subsistence agricultural economy which received much less scientific attention (Eisemon et al., 1985).⁴ Even if food crops were assigned priorities after independence, export crops continue to be predominant in agricultural research. This is in part due to the fact that taxes levied on them provide convertible currency revenue for the governments. Thus, in Nigeria, during the Second National Development Plan (1970–1974), 63 per cent of the agricultural research budget was earmarked for export crops, while food crops received only 33 per cent (Idachaba, 1980).

Until shortly before independence, Nigerians did not participate in the scientific development of their country. Indeed, facilities for the scientific training of Africans did not exist before the establishment of Ibadan University College affiliated to the University of London in 1948 during the closing period of colonialism.⁵ This was just the first stage of an important university development. As Davis (1983) points out, scientific research in Nigeria has since become largely a university concern (according to the British tradition), while in Francophone countries it has been linked more to specialized institutions.⁶

The Considerable Expansion of the Nigerian University System⁷

It was during the latter part of the colonial period that a Nigerian scientific elite began to take shape. The first Nigerian scientists attended Ibadan University College and went abroad for higher levels of specialization. It was then a widely held view in the colonial administration that the university college should limit its programmes to mainly general courses and that the best graduates from the system should be sent to the United Kingdom for postgraduate courses. The demand for higher education, as indicated by the number of students studying abroad, was rising.⁸ The first generation of Nigerian scientists have studied abroad. In the 1950s and 1960s, universities in the United Kingdom, especially the universities of London and Edinburgh, were preferred for postgraduate training abroad. In the late 1960s, an increased number of students went to study in the United States⁹ and Black American accents became commonly heard on Nigerian university campuses.¹⁰

According to Adamson (1981), Nigerian researchers soon divided into two rival groups—one supporting the English tradition and the other the American tradition. The distinction between the two groups progressively died out as training diversified. Despite the existence of some nationalist trends, Nigeria does not seem to have experienced any real conflict between national and colonial modes of the magnitude known in India (see Krishna, 1992).

During the early years of independence, there was considerable expansion of the Nigerian university system. From independence to date, twenty-one federal, one military, and nine state universities were established. Today, Nigeria has the largest and most diversified system of higher education in Sub-Saharan Africa. There have been three major periods of university development: the first in the 1960s and early 1970s, when the first generation universities were established; the second in the mid-1970s, when seven more were created; and the third, mainly in the early 1980s, when seven federal universities of technology and nine state universities were established (Table 5.1).

The responsibility for higher education is shared between the local, state and federal governments. Private universities, after a brief experiment in the early 1980s, were prohibited in 1984 due to a mushrooming of institutions of entirely unsatisfactory effectiveness (World Bank, 1988). Student enrollment rose from less than 1,000 in 1960 to close to 150,000 students in 1990.¹¹ Overall, the rapid expansion of university enrollments has been matched by increases in academic staff until the early 1980s when the third generation universities were established. The relative total dependence on faculty expatriates has fallen continuously since 1965, but the absolute numbers remain high (Table 5.2).

TABLE 5.1
The Nigerian Universities

<i>Name</i>	<i>Year of Establishment</i>	<i>Student Enrollments till 1989-90</i>
<i>First Generation Universities</i>		
University of Ibadan	1948	12403
University of Nigeria, Nsukka	1960	12403
University of Lagos	1962	10000
O.A.U. University	1962	12479
Ahmadu Bello University	1962	15103
University of Benin	1970	10000
<i>Second Generation Universities</i>		
Bayero University	1975	less than 3000
University of Calabar	1975	less than 3000
University of Port-Harcourt	1975	less than 3000
University of Ilorin	1975	less than 3000
University of Maiduguri	1975	less than 3000
University of Jos	1975	less than 3000
University of Sokoto	1975	less than 3000
<i>Third Generation Universities</i>		
University of Technology, Makurdi	1980	less than 3000
University of Technology, Owerri	1980	less than 3000
University of Technology, Yola	1980	less than 3000
University of Technology, Akure	1980	less than 3000
University of Technology, Bauchi	1980	less than 3000
University of Technology, Minna	1980	less than 3000
National Open University, Abuja	1980	less than 3000
The Military University	1989-1990	less than 3000
University of Abuja	1989-1990	less than 3000
<i>State Universities</i>		
Rivers State University of Science	1980	less than 3000
Anambra University of Technology	1981	less than 3000
Bendel State University, Ekpoma	1981	less than 3000
Ondo State University	1983	less than 3000
Imo State University	1983	less than 3000
Ogun State University	1983	less than 3000
Lagos State University	1983	less than 3000
Oyo State University	1989	less than 3000
Cross River State University	1989	less than 3000

Source: Bako (1990).

The first generation universities tend to have less than 10 per cent of their academic staff composed of expatriates.¹² Conversely, some of the second phase universities remain highly dependent on expatriates. At the University of Sokoto, for example, they comprised 37 per cent of the total academic staff and 74 per cent of the professorial and senior lecturer categories in the mid-1980s. In three other second generation universities

TABLE 5.2
Teaching Staff in Nigerian Federal Universities, 1965–66 to 1984–85

	1965	1968	1971	1974	1977	1981	1982	1983	1984
Total faculty	1208	1288	2245	3560	5190	7980	8286	8829	8770
No. of expatriates	640	540	606	890	1142	1576	1823	1767	1579
Percentage of expatriates	53	42	27	25	22	20	22	20	18

Source: World Bank (1988).

(Jos, Kano and Maiduguri), more than 30 per cent of the total academic staff and over 50 per cent of the professorial and senior lecturer grades were expatriates during the same period (World Bank, 1988). Today, many expatriate teachers have most likely resigned their posts and left the country, as the foreign currency value of their salaries has been greatly reduced in the late 1980s and early 1990s.¹³

The second and third waves of university expansion were made possible due to the rapid growth of oil revenues during 1973–1980. Although oil prices fell subsequently, the Nigerian government remained committed to the creation of new universities. The very rapid rate of expansion of new universities had a clear negative impact on the financing of the older universities. Shortage of experienced teachers (Nigerian or expatriate) became a serious problem by the early 1980s, when many universities had to rely on teachers on short-term contracts. Overall, shortage of funds has been a problem since the mid-1970s and became particularly acute in the mid-1980s, at the same time when debt servicing increased dramatically. At that time, most universities experienced budget cuts from 50 to 80 per cent. Consequently, many universities could not maintain existing academic facilities, pay lecturers and provide funding for research programmes.

These problems were aggravated by the lack of continuity of the universities' leaderships. According to Kolinsky (1985), many universities had a rapid succession of vice-chancellors for brief periods, which meant that long-term planning was nearly impossible. Furthermore, in spite of the phenomenal growth in enrollments, the needs for higher education are far from being satisfied: out of 233,531 applications, only 33,064 were selected in the country's thirty-one universities in 1990 (Bako, 1990). Yet, while the demands from the states to fill their expanding civil services and the increasing demand for teachers led to virtually full employment of university graduates during the 1970s, there is today widespread unemployment among them.¹⁴

The IMF/World Bank programmes and policies have contributed to this situation. The World Bank emphasis on 'the poorest-of-the-poor' towards the end of the 1970s has certainly shifted the resources of some

donors to some of the least developed countries. Another negative effect of the structural adjustment programme has been the dramatic reduction of the purchasing power of civil servants in general and the consequent massive loss of teaching staff and researchers.¹⁵ A recent investigation conducted at the biggest university in Nigeria, the Ahmadu Bello Zaria, shows that 80 per cent of the senior staff had left in the late 1980s (*Today's Newspaper*, 1990).

Yet, one should not underestimate the impressive achievements of Nigerian universities as centres of learning and research. Over a very short period of time, they have produced a large number of graduates, provided services to people outside the university system and significantly contributed to Nigerian research outputs, as shown later in this chapter. Thus, it is estimated that Nigerian universities represent about 85 per cent of the total research output in Nigeria measured in number of mainstream publications. It is, however, doubtful whether the overall Nigerian university system, given its excessive expansion and consequent cost, is sustainable in the present economic crisis.

The Federal Research Institutes

Research activities are also carried out in twenty-two federal research institutes which collectively employed about 15,000 scientists and supporting staff in the mid-1980s. As illustrated in Table 5.3, most of the research activity is now oriented towards the use of the natural resources found in Nigeria. There is considerable size variation amongst the institutions, with some employing 100–300 workers, and others employing around 2,000. In general, the largest institutions (like the Cocoa Research Institute and the Forestry Research Institute) tend to be the oldest, while the smallest tend to be the most recent ones (Table 5.3).

A survey of these institutes was carried out by Clark (1980) during the summer of 1977. Information was collected from seventeen institutions. As far as disciplines are concerned, Clark found that the biggest broad category of scientists was that of plant scientists who comprised 62 per cent of total manpower. Within this category, agronomists made up 42 per cent (or 26 per cent of the total), while plant pathologists and soil scientists made up another 40 per cent in roughly equal proportions. Four other broad categories (engineering, animal sciences, social sciences and other sciences) represented around 10 per cent each. Among social scientists, the economists were not integrated directly into the formulation of research projects but were usually involved either in extension work or in specific social studies along with sociologists.

According to the same survey, junior supporting staff, who comprised practically 90 per cent of the total, were overwhelmingly preponderant,

TABLE 5.3
The Federal Research Institutes

<i>Institute</i>	<i>Speciality</i>	<i>Location</i>
Cereal Research Institute	Rice, maize and other cereals	Ibadan
Institute of Agriculture Research and Training	Lowland rain forests	Ife
Institute of Agriculture Research	Sudan and Sahel savannah zone	Zaria
Horticulture Research Institute	Fruits and vegetables	Ibadan
Root Crops Research Institute	Cassava, yams, other root crops	Umudlike
Cocoa Research Institute	Cocoa, coffee, kolanuts	Ibadan
Institute for Oil Palm Research	Oil palm and other palms	Benin
Rubber Research Institute	Rubber	Benin
Agricultural Extension and Research Liaison Services	Information and extension	Zaria
Stored Products Research Institute	Storage and preservation	Lagos
Forestry Research Institute	Forestry and wildlife	Ibadan
Lake Chad Research Institute	Resources of inland lakes	Maiduguri
Kainji Lake Research Institute	Resources of man-made lakes	Kainji
Institute of Oceanography and Marine Research	Oceanography and marine resources	Lagos
Animal Production Research Institute	Livestock production	Zaria
Veterinary Research Institute	Livestock diseases	Jos
Institute of Trypanosomiasis Research	Trypanosomiasis	Kaduna
Leather Research Institute	Leather utilization	Zaria
Institute for Medical Research	Medical research	Lagos
Federal Institute for Industrial Research	Food science and related fields	Lagos
Projects Development Institute	Engineering design and development	Enugu
Building and Road Research Institute	Materials and design	Lagos

Source: Schweitzer (1986).

while the proportion of actual research scientists averaged about 5 per cent of the total. In terms of qualifications, around 25 per cent of the research staff possessed PhD degrees, 25 per cent MSc, and 50 per cent BSc degrees. Overall, the skill level of the research scientists in the federal research institutes is lower compared with that of the universities (particularly the oldest universities). Practically all institutes had difficulties in recruiting and retaining suitably qualified staff in the late 1970s, the universities being at that time, and on the whole, more able to offer better career opportunities, better conditions of service and better research facilities.

Many institutes provide a variety of services (some institutes carry out extension and liaison work),¹⁶ but on the whole they are more concerned with transferring technologies already developed. The links with the client

sector to develop research programmes at their conception phase do not appear to be very close (Clark, 1980). Much of the time of the research staff is also devoted to education and training, and to routine testing and maintenance services (Schweitzer, 1986).

The National Science Policy System

Following political independence (proclaimed on 1 October 1960) and the dissolution of WACRO in 1962, the need to create a central coordinating body for research activities received increasing attention in the Nigerian scientific establishment. UNESCO's Lagos Conference on 'The Organization of Research and Training in Africa' held in 1964, reinforced, without any doubt, this need. There were several attempts at organization which then vanished without much effect.¹⁷ The Nigerian Council for Science and Technology (NCST), set up in 1970, lasted longer than the earlier structures and made its mark on the country's scientific community. The creation and organization of the NCST was largely based upon a report prepared by a UNESCO expert, Dr N.R. Martin (Martin, 1970).

NCST was a council and not an autonomous body. With the creation of NCST, Nigerian science policy making and research planning had a three-tier structure, consisting of NCST as the first level of policy making, the research councils as the second level, and both research institutes and university departments as the third level. The research councils represented four major areas of research, already much farther afield than those of WACRO. They were: agriculture (the Agricultural Research Council of Nigeria—ARCN), industry (the Industrial Research Council of Nigeria—IRCEN), medicine (the Medical Research Council of Nigeria—MRCN) and natural sciences (the Natural Sciences Research Council of Nigeria—NSRCN). Looking back at the period of NCST control, it seems to have been one of liberalism and relative independence for the various institutions. Basic research prospered.

That liberal period was short lived. Political unrest and the military takeover soon drove the country to a much more interventionist system of scientific activity. A first step towards a new science policy came with the setting up of the National Science and Technology Development Agency (NSTDA) in 1977. This agency (rather than council) had greater managerial powers. Two years later, in 1979, the NSTDA became the Federal Ministry of Science and Technology. It was devoted to increasing the country's S&T activities, and showed a greater desire to manage and control. Bureaucracy became more important. One of the main arguments for consolidating the supervision of research within a central ministry included the need for a strong organizational advocate for research during the time of budget retrenchments and the Ministry's beginnings were indeed marked by a

substantial growth in research budgets. Another argument was the opportunities for transferring knowledge among ministries and between federal and state agencies that could be promoted by a central organization (Schweitzer, 1986). However, with successive decreasing budgets, the effective role of the Ministry seems to have been greatly reduced.

The decade of the 1970s was a period of growth for the Nigerian scientific community. Adamson (1981) showed the spectacular growth in the number of university academicians publishing in scientific reviews. The country's six oldest universities were considered in two five-year periods (1970–1974 and 1975–1979). The number of published university academicians or researchers associated with the universities (Institute of Agricultural Research, Institute for Agricultural Research and Training, etc.) doubled from one period to the next. Davis (1983) indicates a similarly clear growth in scientific production (number of papers published) in Nigeria during the 1970s. That growth was also one of the offshoots of the genuine economic boom from which Nigeria, a petroleum exporting country since 1969, prospered. Scientific research and university education thus benefited from favourable funding and worked to develop technological studies. Petroleum production guided development towards the industrial sector, to the detriment of agriculture.

With the petroleum crisis, which began in 1981, Nigeria toppled into a serious economic recession. The country turned back to agricultural production and manufacturing industries. Scientific activities were affected. According to Eisemon and Davis,¹⁸ the number of Nigerian scientific authors publishing in the most influential international scientific journals monitored by the Institute for Scientific Information (ISI) continued to increase until 1987—when it reached a peak of slightly more than 1,400 a year—to decrease to slightly more than 700 in 1991. Yet, when using a sub-base of the latter, the Research Front Database (which is even more selective),¹⁹ we find that the number of publications published by Nigerian scientists has remained surprisingly constant between 1988 and 1990.²⁰ This suggests that there was a core of academic scientists in Nigeria who continued to be active and publish in highly reputed journals despite the crisis. Nevertheless, the Nigerian scientific community has to be considered as having spent a full decade in a state of crisis (worsened by the political crisis which we have not even touched on here). Despite these difficulties, the Nigerian scientific community continues to publish and to conserve its supremacy in Sub-Saharan Africa (excluding South Africa), as we shall see in the next part of this chapter.

Nigerian Research Output in the African Landscape

It is now widely accepted that the picture of Third World countries' scientific production has been distorted by the use of overly selective

bibliographical databases.²¹ Yet, a number of earlier bibliometric studies have shown that the PASCAL database, established and managed by the Institut National pour l'Information Scientifique et Technique (France), is of particular interest in the context of peripheral countries or communities (Chatelin and Arvanitis, 1988, 1992).²²

For this present study, we have worked on the PASCAL database for the years 1987, 1988, 1989 and 1990. We have resorted to two levels of analysis. The first involves straightforward database interrogation and the second, the interrogation, retrieval and then processing of bibliographical information. The first level of analysis consists of interrogating the database to obtain the number of references affiliated in each country. We thus obtained the scientific production designated strictly as coming from a country's national laboratories. All publications to do with the country but produced elsewhere were excluded. An initial interrogation gave us the total number of references for each African country.

For the three most important countries, we proceeded with further interrogation so as to obtain the number of references pertaining to four major scientific areas: Physics, Chemistry, Technology; Land, Sea Space; Agricultural Sciences; and Medical Sciences. For Nigeria, we once again interrogated the PASCAL database, asking not only for the references affiliated (by the first author) in the country itself, but also for all the references affiliated in another country, though nonetheless concerning Nigeria. The latter are references where the word Nigeria figures either in the title or among the keywords. The whole body of references were drawn from the PASCAL database and then processed. Unlike the preceding stages, which went on an automatic interrogation of the database, the processing here consisted of examining each bibliographical item, one by one. As an interpreting aid, we used the database classification scheme and keywords introduced by the PASCAL database. The processing was aimed at obtaining a certain number of numerical indicators (on the authors, countries and publications) and establishing a thematic analysis of the scientific production concerning Nigeria.

Major Features of African Production

The broad lines of the African continent's scientific stage over the past two decades have been described by Rabkin et al. (1979), Davis (1983), and Gaillard and Waast (1988, 1992). We shall compare some of the results of these earlier studies with those obtained by our investigation.

There are over forty countries in the African continent. From the four years of the PASCAL database, we compiled 24,596 bibliographical references affiliated to those countries. Yet, scientific production is very heterogeneously spread. The Republic of South Africa alone accounts for a third of the publications. The top ten countries represent 88 per cent of the

continental scientific production. Five of them belong to the English-speaking world (South Africa, Egypt, Nigeria, Kenya and Zimbabwe), with the other five belonging to the Francophone world (Tunisia, Morocco, Algeria, the Ivory Coast and Senegal). For sure, PASCAL is somewhat biased in favour of the latter (Table 5.4). Among these ten countries, we distinguished three groups, separated by differences of both a quantitative (number of publications) and qualitative (themes treated) kind. Nigeria is ranked third in the first group after South Africa and Egypt. Nigeria alone produces almost as many publications as the next four most important countries together.

TABLE 5.4
Number of References from the Ten Most Productive Countries, 1987–90

<i>Country</i>	<i>Number of References</i>
<i>First Group</i>	
South Africa	8101
Egypt	4921
Nigeria	3570
<i>Second Group</i>	
Tunisia	1287
Morocco	969
Kenya	821
<i>Third Group</i>	
Ivory Coast	547
Algeria	515
Zimbabwe	432
Senegal	429

When we consider Black Africa (excluding the Republic of South Africa and North Africa), Nigeria's supremacy becomes overwhelming (see Figure 5.1). Nigeria produced 3,570 of the 8,603 references recorded for Black Africa as a whole. It therefore represents more than 41 per cent of Black Africa proper, a percentage which would probably have been somewhat greater had there been no linguistic bias in favour of the Francophone countries.

These results should be put alongside those obtained by Davis (1983) for whom Nigeria and Kenya represented 41 per cent of Black Africa's scientific production in 1970 and 59 per cent in 1979. According to our survey covering the period 1987–1990, these two countries represent 51 per cent of Black Africa as a whole. Therefore, despite the differences introduced by the bibliographical databases consulted by Davis and ourselves, Nigeria's huge supremacy in Sub-Saharan Africa is confirmed. Like the majority of developing countries, Nigeria devotes a larger share of its research activity to the areas of medicine and agricultural sciences (Table 5.5).

FIGURE 5.1
The Five Most Productive Countries in Sub-Saharan Africa
 (excluding South Africa)

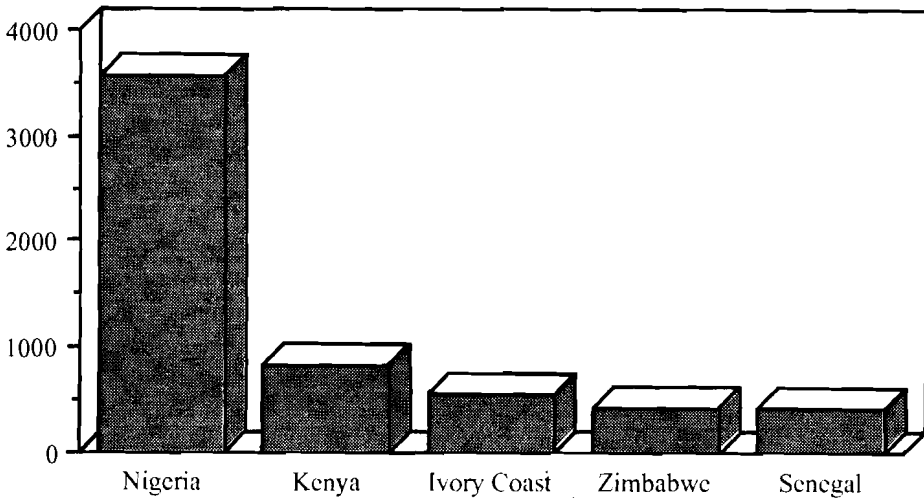


TABLE 5.5
Thematic Distribution of the Top Three Countries—Main Research Areas
 (Percentage)

Countries	Physics, Chemistry, Technology	Earth, Ocean and Space	Agricultural Sciences	Medicine	Others
South Africa	18.2	17.0	9.5	29.2	26.1
Egypt	42.2	12.8	14.5	13.8	16.7
Nigeria	12.7	13.4	26.9	32.7	14.3

Once again, there is a fair correspondence with Davis' study (1983) according to which, for Black Africa as a whole, physical sciences represent 10.1 per cent of papers published, natural sciences 7.1 per cent, agronomy 22.3 per cent, medicine 38.2 per cent and biology 22.4 per cent. In our study, the interrogations carried out on the other countries in the first group (the Republic of South Africa and Egypt) were not controlled with complementary analyses as was the case with Nigeria. The comparison of the three countries has therefore to be considered with some caution.

The Orientations of Nigerian Research

The four scientific areas used for comparing the whole body of African countries were defined expressly to enable an easy interrogation of the PASCAL database. For a more detailed analysis, we characterized Nigerian scientific production according to seven areas, presented in descending order according to their numbers of publications (see Figure 5.2).

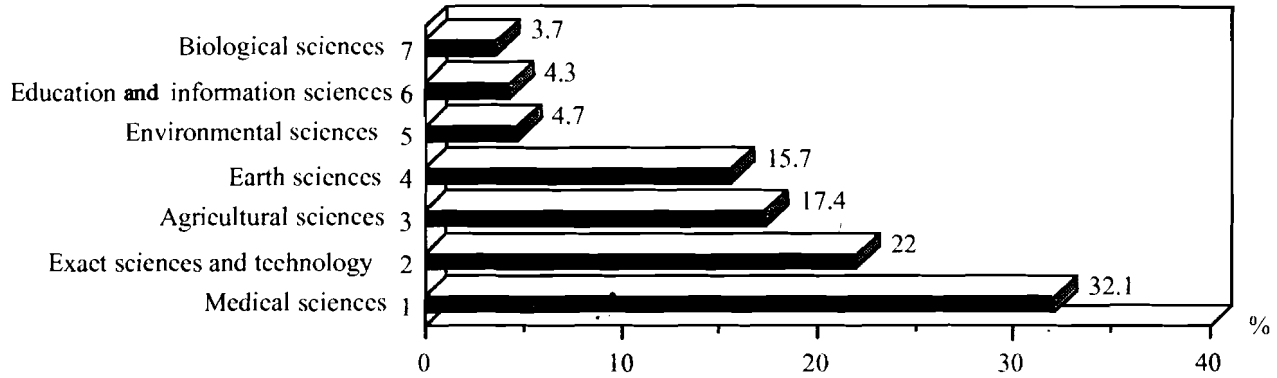
Medical sciences is the most important area (in terms of numbers of publications). It is characterized (as in every country) by the very large share of hospital activity linked clinical studies. Nearly a third of these are to do with paediatrics. We noticed the presence of some studies on contraception (completely lacking in many other countries). The second medical publications group, in order of size, is made up of public health, nutrition and epidemiology. Laboratory work constitutes the third group. This is the one which includes the most basic or advanced research. For a developing country, Nigeria is significantly visible in the areas of immunology, human genetics and, above all, pharmacological research.

The second most important area is exact sciences and technology. It includes a variety of disciplines whose common point is that none depend on either local, ecological or human conditions. Some authors define them as 'cosmopolitan' (Rabkin et al., 1979). The research carried out in this area differs little from one country to the next. Thus, we found a significant presence of mathematicians, statisticians and computer scientists in the Nigerian scientific community. There are also many publications in physics and, above all, chemistry (often focusing on industrial problems). Moreover, Nigeria devotes a great deal of effort to biotechnologies and the food industry. Technological research on energy and civil engineering is also noticeable. The relative importance of this second area sets Nigeria clearly apart from other Black African countries.

Agricultural sciences come in third place. Appearing in this area are the usual themes of agronomical research in tropical countries, that is, crop fertilization, water supply, plant breeding, atmospheric nitrogen fixation, crop protection, zootechnics and veterinary medicine, silviculture and natural resource conservation. As with all developing countries, these are indispensable fields of research, whose distribution in Nigeria does not seem to mark any particular originality. It is only by going into the details that one might suspect some shortcomings (in virology, maybe, or nematology), a discussion of which is impossible here.

Earth science publications (geophysics, geology, tectonics, geomorphology and soil science), which make up the fourth area, are almost as numerous as those in agronomical disciplines. Earth sciences rarely have such a great relative importance in other African countries. Nigeria's mining interests (petroleum, gas, coal, iron ore, gold, etc.) undoubtedly constitute a motivating factor. However, they are not enough to explain the diversity of the

FIGURE 5.2
Main Scientific Orientations of Nigerian Science



studies produced and, for instance, such a high number of publications on soil science. Highly specialized or basic research efforts are visible in geochronology, astrochemistry, archaeology and pre-history.

Unfortunately, the fifth and seventh areas (climate and aquatic environments, and biology and ecology) are not developed enough. As in many other developing countries, Nigeria's scientific community seems very much drawn by the basic disciplines and advanced technologies. Despite Nigeria being a seaboard land with a strong network of rivers, relatively few studies are devoted to marine biology, fresh water biology, fisheries and aquaculture. Similarly, study of the country's large-scale natural formations (ecosystems of forests and savannah) seems neglected. The sixth area (information and educational sciences) is not easy to compare. While present in the PASCAL database, it would probably be better-off grouped with the social sciences (not considered here).

Bibliometric Indicators

A national system of research is formed of elements (institutions, laboratories, researchers) belonging to the country and elements from abroad. We are above all looking at the relationship between the two here, insofar as they can be grasped by the analysis of scientific production. No research system (especially in a developing country) can be made exclusively of national elements. Depending on the case in hand, the importance of the link with (or dependence on) foreign elements can vary both quantitatively and qualitatively. A first question to ask concerns the localization of research, that is, located within the country or outside. The ratio of numbers of publications affiliated in the country to the total number of publications defines the 'indicator of national affiliation' (Table 5.6).

A second question relates more directly to the way research is operated. Bibliometrics provides an approach by defining an 'indicator of associativity' (Table 5.7), which represents the average number of authors per publication.

TABLE 5.6
Indicator of National Affiliation

(Percentage)

<i>Country</i>	<i>Indicator of Affiliation</i>
Nigeria	90.8
Ghana	53.2
Kenya	55.0
Ivory Coast	62.4
Senegal	55.4
Burkina Faso	38.0
Niger	38.4

TABLE 5.7
Indicator of Associativity

<i>Country</i>	<i>Indicator of Associativity</i>
Nigeria	1.9
Ghana	2.2
Kenya	2.8
Ivory Coast	3.2
Senegal	2.8
Burkina Faso	2.7
Niger	2.5

A third question to which bibliometrical analysis easily responds is that of 'editorial dependence'. Black Africa is obviously extremely poor in terms of editorial capacities. Some countries nonetheless publish scientific (especially medical) journals of which the PASCAL database regularly takes stock. In the case of Nigeria, as we have defined it, 91 per cent of the publications are printed in a country of the North. Among the developing countries, African or others, we notice that there are three which have published a greater number of studies concerning Nigeria than Nigeria itself. They are, in ascending order, Zimbabwe, India and Kenya.

A Marked National Character

The Nigerian scientific system has a marked national character. This is what is first shown by the very large amount of studies affiliated to national soil. We are not trying to say that Nigeria is a closed or unwelcoming country but, relatively speaking, there is less research conducted there from abroad than in other African countries. Similarly, international institutions set up on national soil (particularly the International Institute for Tropical Agriculture—IITA) represent too small a share of the national system²³ to enable easy comparison with other international institutions in other countries (Kenya, for example). This goes hand-in-hand with the lowest rate of associativity observed for any of the Black African countries we studied. Comparison with other countries, particularly the heavily assisted ones (Burkina Faso, The Niger), shows that associativity really grows when a country opens up to the outside world. While it may be gaining in scientific autonomy, Nigeria does not appear to be too successful at creating the real internal dynamism (and associativity) which would be desired today. The economic and social situation of Nigeria in the course of the past decades is largely reflected in its scientific production. We have already noted the supremacy of the agronomical and medical disciplines (common to all developing countries). We should also highlight the (relatively) larger numbers of studies on food production technologies,

petrol-related geology and petrol industry technology. Being undoubtedly overly focused on more pressing problems, the Nigerian scientific system is little interested in the environment, in the broad sense of the term. Although this, as we see it, is a common flaw in Black African research systems, it is worse here. According to our bibliometric investigations, and as a percentage of the whole body of studies published by each country, Nigeria devotes half as much effort than the Ivory Coast to studying climate, aquatic environments (continental and oceanic waters) and land-based ecosystems.²⁴

A Community Carried by the English-speaking World

Although some sides of scientific Nigeria are relatively closed in on itself, elsewhere it seems to fit easily into the Anglophone world (and into the predominantly English-speaking world of international science). This is probably what explains the apparent lack of national scientific publication. Nigerian researchers publish half of their studies in Great Britain or the United States. The rest scatter far and wide, chiefly going out to reviews in Holland (a country with a highly international publishing capacity), the Federal Republic of Germany, France, Switzerland, Italy, Denmark, Japan, etc. Opening up to the English-speaking world definitely plays a stimulating role. In consulting each and every bibliographical item, one after the other, and noticing how broadly they are dispersed, it really does seem as though the Nigerian researcher has little trouble finding a review which will accept the type of work he/she has conducted.

From the consultation of all the bibliographical items, it also struck us that this manner of publication enhances scientific quality. Here is an example. Medical production always includes a great many clinical reports (case observations). Several African reviews (in Senegal, the Ivory Coast, Kenya) specialize in such reports. Nigerian doctors publish their clinical observations in a Kenyan (English language) review and in the journals of many countries of the North. In the latter, clinical reports appear in a more scientific form and are more readily accompanied by laboratory analysis results.

The attraction exerted by a powerful and diversified English-speaking world of science contributes to providing the Nigerian community with some of its own features. The situation is different with Senegal, for example, where publications essentially appear in the French language, over half of them being published in France.²⁵ It is also different in Egypt or the Maghreb countries, where, even in the scientific domain, Arabic plays an exceedingly important role.

The Impact on Development

To what extent has Nigerian science had an impact on the nation's economic and social development? Given the sizeable research investments and the substantial research outputs produced by the Nigerian scientific community during the past three decades, an answer to such a question seems warranted. During the early 1980s, the Nigerian government started to question the return on investments in scientific research. This forced the executive agencies to document with more care the activities of the research institutions (Schweitzer, 1986). Judging from the studies available, these investments have had mixed or limited impacts on development, even though there are many priority development activities which could benefit from inputs from Nigerian researchers.

Idachaba (1980) studied changes in agriculture by looking at yield increases and sustainability of yield increases per plant and per region over a ten to fifteen year period, and in relation to recommendations made by the research and extension services. The results are varied. For certain plants such as rice, cotton, cocoa and millets, significant success is related to the selection of high yielding varieties. The Institute for Agricultural Research (IAR) (rice and cotton) and the Cocoa Research Institute of Nigeria (CRIN) (cocoa) have the most applicable and practical results. They publish (by far) the most and their work is most often cited. Questionable results have been obtained on sorghum, chick peas and groundnuts. Maize production has definitely dropped. Positive results were obtained when political leaders, research scientists and well-organized producers cooperated closely, and when research institutes had the right scientific ambition and proper management. But, technologies and improved varieties are often not sufficiently adapted to local agro-ecological conditions. Idachaba (1992) suggests a list of five factors accounting for this perennial problem: (a) laziness on the part of researchers who are content with research stations' results in the vicinity of their host institution; (b) the structure of incentives and rewards which are mainly based on publication outputs; (c) poor research management at the institute level; (d) the 'recurrent cost trap', especially transport and travelling in which research administrators often find themselves; and (e) the low level of mobilization of the intended beneficiaries.

As we have seen earlier, most research is done in universities where success means being published by international journals rather than helping local industry (Ogbimi, 1990). Publications in local journals are not given much recognition even if they may be more instrumental in the local implementation of research results. Researchers have no real incentives to research for practical results, provided they can publish their results in reputed journals and be promoted. Furthermore, the inter-disciplinary team approach to research is not very common²⁶ and research programmes

seldom incorporate the practical concerns of the users.²⁷ Another weak link in the system for commercializing research results and diffusing technologies in Nigeria is the absence of a strong engineering industry. Yet, the adaptation activities of Nigerian firms with strong international ties are often significant, even if they do not lead to fundamentally new products or processes. In several laboratories of international firms, modest product development activities are taking place. A greater exposure of Nigerian scientists in the federal research institutes and universities to the technical and management approaches of these firms would certainly be beneficial (Schweitzer, 1986).

Overall, research has tended to be supply driven rather than demand driven and the recommendation made by Idachaba (1992) for agricultural research is relevant for many other research areas: 'The challenge is to evolve workable mechanisms for promoting dialogue between researchers and the end-users (farmers) of (agricultural) technologies on the one hand, and between researchers and consumers on the other at the predesign stage rather than at the pre-extension and pre-consumption stage' (ibid.: 5).

The problem of linkages between research and development is one of the major challenges for the Nigerian scientific community. There is an urgent need to transform the research system into a more demand driven system within the existing resources. Even there, the community is facing yet another challenge as most institutions are experiencing successive budget cuts.

Budgetary Restrictions, Deteriorating Conditions and Survival Mechanisms: Resisting the Crisis?

Following increased budgetary restrictions and the depreciation of the Naira in 1986, the provision of scientific equipments, supplies, books and journals has been severely curtailed. The 'fringe benefits' of academic life, which used to be very attractive after independence, have also clearly deteriorated, if not disappeared completely. The recent statement of a Nigerian scientist (Irele, 1989: 132) from the University of Ibadan is revealing of the difficulties under which research activities are carried out today even in the oldest Nigerian university:

Because resources have had to be stretched, all the universities in Nigeria now suffer from an acute shortage of facilities. So severe indeed has been the rundown of the infrastructure in some of the older universities that routine teaching is difficult and research often impossible. At the University of Ibadan, for example, which is my alma mater and now the university where I teach, we have been battling for the past ten years with supplying water and electricity. Scientific instruments, not the most

sophisticated, have broken down and cannot be repaired for lack of spare parts or expertise. The purchase and installation of serviceable equipment is out of the question because of foreign-exchange problems; even the most common chemicals and reagents are in such short supply that science teaching has to do without the standard discipline of experiments. In these conditions, no serious research is possible.

The question is, to what extent and how has the community been able to adapt to such a situation? A survey of 178 scientists in the departments of chemistry, geology and physics of four Nigerian universities carried out in May and June 1986 confirms the testimony of Irele, but at the same time illustrates attempts by the scientists to organize survival mechanisms (Ehikhamenor, 1990). According to the results of this survey, lack of equipment was a serious problem for 78 per cent of the scientists interviewed. More scientists (82 per cent) complained about lack of information as a constraint to research. At the time of the survey, most university libraries had been unable to renew most of their subscriptions for four years. At the University of Ibadan, subscriptions for about 5,700 journals had been cancelled, leaving only about 300 (Eisemon and Davis, 1991). This problem is exacerbated by the fact that most scientists are today unable to subscribe privately to their favourite journals.

Surprisingly, out of the 178 scientists surveyed by Ehikhamenor (1990), only three had given up research activities completely. Fourteen per cent had to change their research orientation to areas where lack of equipment would not be a problem. Nine per cent reported that they got part of their research work done outside Nigeria, which meant travelling overseas to do so, or sometimes involving a colleague overseas in doing an aspect of the research requiring equipment not available locally. Survival strategies are also adopted to contend with the problem of lack of information. As many as 36 per cent of the scientists interviewed reported being able to meet part of their information requirement thanks to the good will of colleagues outside Nigeria who did literature searches for them and supplied them with photocopies of articles. Many of them (35 per cent) used the opportunity of a trip abroad to study the literature. Another 23 per cent depended largely on the few journals they could access; while 12 per cent obtained some information through scientific societies. Even the comments of referees on manuscripts submitted for publication turned out to be an important current awareness service to several scientists. As Ehikhamenor correctly remarks, however, many scientists could not benefit from these survival strategies, and even when they could, research projects had to be suspended for long periods while the scientists waited to receive scientific information or analyses from abroad, or while they waited for the opportunities to travel or send research material overseas.

Conclusion

Is the Nigerian scientific community, which began to enjoy an enviable international reputation during the 1970s, on the verge of collapse? Many sensible observers, Nigerians or foreigners, who have been to Nigeria recently or who are still actively involved in research activities there are indeed spreading very alarming reports.²⁸ International funding research programmes active in Nigeria for many years are also reporting decreasing numbers of research grant applications submitted by Nigerian scientists or institutions in a context of steadily decreasing research budgets.²⁹ Outflow of high skilled Nigerian professionals has also been on the rise, particularly since the later part of the 1980s.³⁰

The euphoria of the 'oil boom years' which led to a 'policy' of rapid and uncontrolled university expansion is over. The government, which is no longer able to sustain the ambitious proliferation of academic courses and programmes at all levels and in all universities, is now pressing its universities to raise at least half of their budgets from private sources before the end of the century (Eisemon and Davis, 1991). This is very unlikely.³¹ University expansion has also led to increased tensions between teaching, advanced postgraduate training and research.

A more realistic approach would advocate the reorganization of higher education and research systems within the limitations of the resources available. This includes a drastic reduction of courses and programmes which are duplicating each other, the closing of a few universities,³² and the concentration of research facilities and resources in a number of carefully selected university laboratories and research centres. Collaborative partnerships between the university system, the research institutes and the private sector should also be fostered in postgraduate training and in research. A national debate involving all actors concerned (scientists, research end-users, consumers, economic planners, etc.) could also be launched as a stimulus to reorient the national research agenda in an appropriate direction, taking both the local needs and conditions and the international environment of Nigeria into account.

The Nigerian scientific community is indeed in a crisis. Yet, Nigeria continues to occupy a singular place on the scientific stage of Africa, one whose contrasts, strengths and weaknesses we have attempted to underline—a state of crisis but a scientific production which continues to represent a very sizeable share of the African production; a highly national character but an opening up to the outside world; a lack of balance in the themes studied, with a clear development of basic or technological disciplines (e.g., mathematics, physics, chemistry) due to the predominance of universities in the national research system; and great neglect of research concerning natural environments. The capacity to sustain the crisis by the core of the

Nigerian scientific community, through varied survival mechanisms, is probably one of the main lessons of the recent period. A tradition of excellence cannot be eradicated abruptly once it has taken roots.

Notes

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1. For a more detailed review on the development of scientific institutions and science in British West Africa and in Nigeria, the interested reader can consult Lord Hailey (1938), E.B. Worthington (1938, 1957), Sir Charles Jeffries (1964) and especially Charles Forman (1940).
2. It was preceded by a number of Imperial conferences on matters of importance to colonial economies: sugar production (1931), cotton production (1930, 1934 and 1938), soil problems (1930), forestry (1920, 1923 and 1928) and agriculture (1927) (Eisemon et al., 1985).
3. The area cultivated greatly expanded during the first part of the century. As a way of illustration, the area cultivated under oil-palm increased by 80 per cent between 1928 and 1935 (Worthington, 1957).
4. This is, however, not true for all subsistence crops. Much attention has been paid in Nigeria, for example, to developing strains of cassava resistant to a viral disease already known as cassava mosaic. Cassava was (and still is) an important staple carbohydrate food almost equal in importance to cereals in Nigeria. Satisfactory resistant cultivars have been produced in Ibadan in Nigeria and distributed to farmers with reasonable success. Yet, the interest for this crop can also be explained by its export potential in the form of tapioca or starch flour (Worthington, 1957).
5. Ibadan was the first university college to be established in Nigeria. It was, however, preceded by the establishment in the 1930s of the Higher College and Medical School at Yaba (near Lagos) by the colonial government. Yaba Higher College closed in December 1947, and equipment and books were transferred to Ibadan.
6. See, as a way of illustration, the chapter on Senegal by Jacques Gaillard in this volume.
7. The origin and development of the Nigerian university system has been well documented by a number of authors (Mellanby, 1958; Fafunwa, 1971; Okafor, 1971; Ike, 1976; Kolinsky, 1985, among others). For a more detailed review, we invite the reader to consult them.
8. Between 1949 and 1956, a total of 210 graduates received degrees from the University of London (Kolinsky, 1985). In 1975–1976, about 500 Nigerians were studying for post-graduate degrees in the physical and biological sciences in the United States and in the United Kingdom (Eisemon, 1979).
9. According to Eisemon (1979), 'American universities became better known in Nigeria, largely through the activities of American philanthropic foundations and the United States Agency for International Development which promoted higher education for development'.
10. Many features of the American higher education system have also been adopted such as the credit system, the semester system, and postgraduate studies involving attendance at courses and seminars.
11. Enrollments in all forms of tertiary education are estimated at about 350,000, of which 150,000 are in universities and 130,000 in technical/vocational institutions.
12. Africanization was particularly rapid during the 1960s at the country's six oldest universities where Nigerians predominated in the science faculties by 1973 (Eisemon, 1979).

13. Particularly since September 1986 when the Naira was substantially depreciated.
14. At the end of 1984, the National Manpower Board attempted to investigate the number of graduates who had found employment by the end of their compulsory year with the National Youth Service Corps (NYSC). The results were depressing. Of those interviewed, jobs had been secured by only 6.7 per cent of college educated graduates, 5.7 per cent of polytechnic graduates and 4.4 per cent of university graduates. Of the university graduates, those who had studied law, medicine or education had the highest employment rates: 19, 14 and 13 per cent respectively. Less than 1 per cent of the arts and science graduates had obtained employment. Twelve months later, a sample of 800 of those initially surveyed were recontacted and 540 responded. The results showed that two years after graduating, a third of the graduates remained unemployed (World Bank, 1988).
15. The World Bank has been operating in Nigeria since the early 1950s. Three main phases can be identified: the first phase between 1952–1977 was that of infrastructural development, the second phase of 1978–1989 was of adjustment, and from 1990 it has been of rehabilitation within the framework of a restructuring programme.
16. The Veterinary Research Institute, for example, prepares and distributes animal vaccines; the Forestry Research Institute distributes improved seedlings to farmers, etc.
17. The federal military government created the Nigerian Council for Scientific and Industrial Research in 1966 to formulate a national science policy and coordinate research, but the Council was not formally inaugurated.
18. See Figure 4.1 in the chapter on Kenya by Eisemon and Davis in this volume.
19. Source: SRI International Science and Technology Programme, based on the ISI Research Front Database.
20. 1988 = 383; 1989 = 393; 1990 = 395.
21. The most recent collection of articles on this issue is presented in Arvanitis and Gaillard (1992).
22. PASCAL has a particular limitation, though, since only the affiliation (i.e., the professional address) of the first author of each publication is indicated. This means that in PASCAL, a publication co-authored by three people working in different countries only appears as a single affiliation. In fact, this constraint is less distorting than we feared. The co-authors of a single publication often belong to the same country, or even to the same institution, so one affiliation is then enough. The different authors are not usually cited in alphabetical order and the main author (whose affiliation is indicated) is the first one placed. Whatever the case, we considered that the bibliometry carried out from the PASCAL database simply constituted a survey-based analysis. Results appearing coherent, when they matched up, were taken to be relevant.
23. The scientific production published by the International Institute for Tropical Agriculture represents about 15 per cent of total Nigerian production in agricultural sciences.
24. The research contribution of the Ivory Coast to environmental science has been heavily influenced and marked by the sustained presence of French researchers active in this area, chiefly from ORSTOM.
25. The attractiveness of French scientific journals has, however, somewhat lessened in Senegal to the benefit of other foreign journals (see the chapter on the Senegalese scientific community by Jacques Gaillard).
26. Breeders, for example, work on their own, rather than with plant pathologists, entomologists or social scientists.
27. The breeder is often more concerned with increasing yields than with developing varieties that are adapted to difficult cropping conditions, such as lack of fertilizers (Idachaba, 1980). Sorghum researchers have encountered rejection in IAR, Samaru, because of poor storage of the stalks of the new varieties which were not suitable for fencing and roofing. Maize researchers have also encountered rejection of new varieties by consumers on grounds of colour and palatability (Idachaba, 1992).
28. Personal communications: International Foundation for Science, National Science Foundation and World Bank. See also Irele (1989).

29. As a way of illustration, the number of applications submitted to the International Foundation for Science based in Sweden has become half between 1990 and 1993 (1990: 116; 1991: 83; 1992: 64; 1993: 55).
30. See the figures in Logan (1992), particularly Tables 2 and 3.
31. At present, only 4 per cent of all university revenues come from such sources (Eisemon and Davis, 1991).
32. Under continued budgetary constraints, some courses and postgraduate programmes have de facto already been abolished. A few universities, although they still exist on paper, are unable to continue to provide regular activities (World Bank, personal communication).

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