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**Statistical Brief on the National Agricultural Research System**  
**of**  
**SUDAN**

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ISNAR INDICATOR SERIES PROJECT: PHASE II  
International Service for National Agricultural Research  
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## ISNAR INDICATOR SERIES PROJECT PHASE II

Decision making in the agricultural research policy area in either domestic, regional, or international fora can only be aided by access to reliable and comprehensive data on these systems. It is for this reason that ISNAR initiated its Indicator Series Project in 1986. The major objective of this project is to collect, process, and analyze reliable and comprehensive time-series data on national agricultural research systems (NARSs) throughout the world in order to identify and report on major trends and emerging policy issues with regard to the development of NARSs. To this end a database has been developed that contains time-series data on agricultural research expenditures and personnel for more than 150 developing and developed countries. These data provide a quantitative basis for more in-depth research policy studies by ISNAR and others.

During the first phase of the project (1986-91), the Indicator Series project team produced two major publications published by Cambridge University Press, namely:

Pardey, P.G., and J. Roseboom. (1989) *ISNAR Agricultural Research Indicator Series: A Global Data Base on National Agricultural Research Systems*, 547 pp.; and

Pardey, P.G., J. Roseboom, and J.R. Anderson, eds. (1991) *Agricultural Research Policy: International Quantitative Perspectives*, 462 pp..

The first publication is a statistical reference volume that provides system-level data on agricultural research personnel and expenditures for 154 countries. The second publication draws on the database to report on the major policy dimensions of agricultural research, with a primary focus on less-developed countries.

Phase II of the Indicator Series Project was initiated in 1992 and seeks to update the database and the policy analyses that accompany it. New ISNAR survey data are being used in conjunction with a large variety of published and "informal" reports in order to produce reliable as well as up-to-date information and statistics about the NARSs.

The country-level data are being published in a series of NARS Statistical Briefs. These briefs include more detailed descriptive information about the institutional structure of the NARS as well as a more comprehensive set of statistics than were reported in the 1989 Indicator Series volume. It is envisaged the country-level data will be assembled and analyzed in a series of regional research reports.

These statistical briefs are not official ISNAR publications; they are not edited or reviewed by ISNAR. The information and data presented have been collected and compiled with due care and all reasonable efforts have been made to ensure their accuracy. Comments, corrections, and additions to the material reported in this brief are welcomed. These briefs may be cited with due acknowledgment.

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# Acronyms

|        |  |        |   |
|--------|--|--------|---|
| AOAD   | Arab Organization for Agricultural Development             | IIMI   | International Irrigation Management Institute                 |
| APRA   | Animal Production Research Administration                  | ISNAR  | International Service for National Agricultural Research      |
| ARC    | Agricultural Research Corporation                          | MAFNR  | Ministry of Agriculture, Food, and Natural Resources          |
| CGIAR  | Consultative Group on Inter-national Agricultural Research | MANRAW | Ministry of Agriculture, Natural Resources, and Animal Wealth |
| DANIDA | Danish International Development Agency                    | NARS   | National Agricultural Research System                         |
| FA     | Faculty of Agriculture                                     | NEAHI  | Near East Animal Health Institute                             |
| FAO    | Food and Agricultural Organization                         | NRC    | National Research Council                                     |
| FAS    | Faculty of Agricultural Sciences                           | OECD   | Organization for Economic Cooperation and Development         |
| FINIDA | Finnish International Development Agency                   | NDP    | United Nations Development Program                            |
| FNRES  | Faculty of Natural Resources and Environmental Studies     | USAID  | United States Agency for International Development            |
| FRC    | Food Research Centre                                       | VRLA   | Veterinary Research Laboratories Administration               |
| FS     | Faculty of Science   | WSARP  | Western Sudan Agricultural Research Project                   |
| FTE    | Full-Time Equivalent                                       |        |   |
| FVM    | Faculty of Veterinary Medicine                             |        |   |
| GDP    | Gross Domestic Product                                     |        |   |
| IAP    | Institute of Animal Production                             |        |   |
| IES    | Institute of Environmental Studies                         |        |   |
| IFAD   | International Fund for Agricultural Development            |        |   |

## 1. Introduction

The primary purpose of this brief is to provide various statistical and institutional details on the development and current status of the public agricultural research system in Sudan. This information has been collected and presented in a systematic way in order to inform and thereby improve research policy formulation with regard to the Sudanese NARS. Most importantly, these data are assembled and reported in a way that makes them directly comparable with the data presented in the other country briefs in this series. And because institutions take time to develop and there are often considerable lags in the agricultural research process, it is necessary for many analytical and policy purposes to have access to longer-run series of data.

NARSs vary markedly in their institutional structure and these institutional aspects can have a substantial and direct effect on their research performance. To provide a basis for analysis and cross-country, over-time comparisons, the various research agencies in a country have been grouped into five general categories; government, semi-public, private, academic, and supranational. A description of these categories is provided in table 1.

Table 1: *Institutional Categories*

| Category      | Description  | Examples                                   |
|---------------|--|--|
| Government    | Agencies directly administered by government.  | Research department within a ministry      |
| Semi-public   | Agencies not directly controlled by government and with no explicit profit making objective. | Research institute under a commodity board |
| Private       | Agencies whose primary activity is the production of goods and services for profit.          | Agricultural machinery or chemical company |
| Academic      | Agencies that combine university-level education with research.                              | Faculty of agriculture                     |
| Supranational | Agencies whose mandate covers more than one country.   | CGIAR institutes                           |

*Note:* Adapted from OECD (1981).

The concept of a NARS used throughout this report includes only those institutes that can be classified as government, semi-public, and academic agencies. Where it is useful to do so, private and supranational research agencies have been discussed, but for reasons of comparability they are not included in the NARS data reported here. More detailed information on the definitions and concepts used in this brief is provided in appendix 2.

Section 2 provides a brief description of the institutional development and current structure of the NARS. Section 3 presents a statistical overview of the longer-run investment trends in agricultural research along with a more detailed look at contemporary investment orientations. The appendices provide further descriptive details and present the basic research personnel and expenditure data in disaggregated fashion. For general background information and statistics on Sudan we refer to appendix 1.

## 2. Agricultural Research Institutions

### 2.1 Historical Evolution<sup>1</sup>

In 1820 the Sudan was invaded by Egypt which in turn was occupied by British forces in 1880. In response to a perceived threat from the French who sought access to the Upper Nile, the British occupied the Sudan in 1898 and signed a British-Egyptian Agreement in 1899. An Anglo-Egyptian administration was established in the Sudan. This administration was effectively a British colonial administration headed by a governor-general in who all civil and military power was vested. Sudanese nationalism grew throughout the 1930s and 1940s, and in 1953 an Anglo-Egyptian Agreement was signed that provided self determination for the Sudanese. Elections for a Sudanese parliament took place and the country gained its political independence in 1956.

#### *Pre-independence*

Formal agricultural research in Sudan began in 1902 with the establishment of experimental farms at Shendi on the Main Nile and El Kamlin on the Blue Nile. One year later two more experimental farms were established at Rumbek and Bahr El Gazal. Cotton dominated the Sudanese economy in the first half of the century. Consequently these early agricultural research activities focused exclusively on cotton production on the irrigated area between the two Niles, which became known as the Gezira scheme. The Welcome Tropical Research Laboratories in Khartoum were also established in 1903. These laboratories were administered by the Department of Education and, among other things, also conducted some chemical and entomological research related to agriculture. In 1904 the Shambat Research Farm was set up and undertook agronomic and botanical research on cotton and wheat. In these initial years, the Shambat Farm and the Welcome Laboratories worked closely together. In fact, from 1912 to 1919 the Shambat Farm was run as part of the Welcome Laboratories. In the years following 1904 several sub-stations were also established. The research stations were initially staffed entirely by British scientists. The Gezira Station, a permanent cotton research station, was established at Wad Medani in 1918 and is now Sudan's main research station.

From 1918 to 1931 the agricultural research stations were administered either by the Department of Agriculture or the Department of Education. The Agriculture Research Service was established in 1931 to consolidate agricultural research being done throughout the Gezira scheme under a single administrative unit. In practice, the unit assumed responsibility for research conducted in other parts of Sudan as well. In 1935 the Agriculture Research Service was integrated into the Department of Agriculture and Forests and renamed the Agricultural Research Institute in 1938. The unit was again renamed in 1944 and became the Research Division.

The pattern of development of Sudan's agricultural research system has always been closely related to broader developments within the agricultural sector. Following the completion of the Sennar dam (1925-1948), Sudanese agriculture continued to focus on the production of export crops, mainly cotton. In this period a number of other research stations involved in cotton research were established. These included the Kadugli Research Station (1935), which

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1 The material presented in this section draws largely from Idris (1969), IADS (1977), Saeed, Ahmed and El Hussein El Tahir (1986), AOAD and ISNAR (1988), ARC (1987), Craig (1991), and Dash (1993).

conducted research on rainfed cotton, and the Yambio Research Station (1948). The demand for locally produced food crops grew markedly during World War II and continued to do so in the years thereafter. These developments, together with the failure of sorghum crops on rainfed, mechanized production schemes in Northern Gedaref, focused the attention of local policymakers on food crop production. Research on mechanized grain production began in 1945 and was expanded to include other food crops in 1952 with the establishment of the Regional Tozi Research Station in the Central Highlands area. The Tozi station conducted research on sorghum, sesame, and groundnuts.

Local veterinary services were first made available at the beginning of this century when a Veterinary Department was established to control serious animal disease outbreaks. In 1913, the department was organized into four sections, one of which was the Veterinary Survey Section. This section was responsible for pathology examination of specimens sent in from the field. The Veterinary Survey Section expanded over the subsequent years to become the Veterinary Research Division under the Ministry of Animal Resources. New diagnostic aids and techniques were gradually introduced that led to the improved identification of animal diseases and facilitated further research.

Fisheries research was initiated in 1953 with the establishment of the Fisheries and Marine Biology Center at El Shagara.

#### *Post-independence*

In 1956 Sudan gained its political independence from the United Kingdom. The country's research stations were staffed mainly with British scientists prior to independence, although the share of national researchers increased rapidly thereafter.

In the early 1960s a number of new research stations were set up which mainly focused on irrigated crops. This reflected the agricultural development strategy of that time which almost exclusively focused on irrigated crop production. A Regional Research Station at Hudeiba was established in 1962 to conduct research on horticultural crops and legumes. In 1963 two research stations were established, one at Sennar, the other at Maatug. The Khashm El Girba Dam on the River Atbara was constructed from 1960 to 1963 to irrigate land for farmers and local nomadic tribes. In 1962 a pilot farm to conduct wheat research was set up at Khashm and upgraded to a research station in 1964. This station was moved to New Halfa in 1979. In 1963 the Tozi Research Station was transferred to the Kenana Research Station at Abu Naama where water for irrigation was more readily available.

Another aspect of Sudan's agricultural development strategy in the 1960s was a shift towards diversifying and intensifying crop production practices, mainly in the Gezira irrigation scheme. New crops like groundnuts and wheat were introduced. The initiation of sugar cane production in the former cotton scheme in Guneid led to the establishment of the Guneid Sugar Cane Research Station in 1963. In 1964 the Yambio Research Station was temporarily closed. During the 1960s the research activities of the Research Division increased substantially and the division became the largest unit within the Department of Agriculture. In an effort to improve its efficiency the division was given the status of an administratively autonomous body within the Ministry of Agriculture in 1967 and renamed the Agricultural Research Cooperation (ARC).

Research on animal production began in 1957 with the establishment of three regional stations at Gazal Gawazat, Um Benin, and Nishishiba. All three stations were initially administered by the Ministry of Animal Production. A further two stations were established, one at El Huda

(1963), the other, a poultry and dairy unit, at Kuku (1964). These five stations were brought together and named the Animal Production Research Administration (APRA) in 1971. The research station at Gazal Gawazat was transferred to ARC in 1980.

At independence, the Veterinary Survey Section consisted of five units: vaccine production, diagnosis, surveying, research, and training. The number of scientific staff continued to grow in the years immediately following independence and eventually led to an acute shortage of facilities and specialized support personnel in the late 1950s. In response to this situation, FAO funds were used to expand the facilities of the research division of the Veterinary Survey Section by constructing the Near East Animal Health Institute (NEAHI). In 1970 the Veterinary Survey Section began building the Central Veterinary Research Laboratory at Soba, which together with five regional laboratories at Juba (former Malakal) (South), Nyala and El Obeid (West), Sennar (Central) and Kassala (East), form the Veterinary Research Laboratories Administration (VRLA).

Forestry research began in 1958 under the Department of Forestry. In 1962 the Forestry Research Institute was created at Soba. The Food Research Center (FRC) was established in Shambat in 1969 part of a joint project of the Ministry of Agriculture and FAO to conduct research and to provide extension and training in the food sciences (including food processing technologies).

In 1970, the National Research Council (NRC) was established by presidential decree to organize and foster scientific research in Sudan. The NRC consists of five sub-councils, one of which is the Agricultural Research Council. The Agricultural Research Council does not have its own research facilities, but does provide funding to individuals, multidisciplinary teams, as well as institutions to conduct agricultural research.

In 1975, the Food Research Center at Shabat, the Fisheries and Marine Biology Center at El Shagara, the Forestry Research Institute at Soba, the Pasture and Range Research Section (of the Range and Pasture Management Administration) at Ghazala Ghawazat, and the Game and Wildlife Research Section (of the Department of Wildlife and Game) at Khartoum were incorporated into ARC, thereby considerably broadening its mandate. This merger was made possible because of the consolidation of the Ministry of Agriculture, the Ministry of Cooperation and Rural Development, and the Ministry of Animal Resources into the Ministry of Agriculture, Food, and Natural Resources (MAFNR) a year earlier. However, livestock research (APRA) and veterinary research (VRLA) were not merged into ARC and remained organized separately. In 1975 the research station at Yambio was also reopened.

In the decade following independence, most of the agricultural research in Sudan focused on the irrigated, modern sector. Only a limited amount of research was directed towards the problems faced by small farmers in the rainfed, traditional agricultural areas in the West and South of the country. In response to this situation, USAID and World Bank funds were used to launch the Western Sudan Agricultural Research Project (WSARP) in 1981. The aim of this project was to develop rainfed agriculture by strengthening the research activities on rainfed crops (e.g., sorghum, millet, and groundnuts), rangeland, and farming systems. WSARP was officially placed within ARC, but the project was effectively run as an autonomous operation with its own budget and administration.

In 1986 the Department of Animal Resources was detached from the Ministry of Agriculture, Food and Natural Resources and became the Ministry of Animal Resources. However, the

Ministry of Animal Resources was again merged with the MAFNR which in turn was renamed the Ministry of Agriculture, Natural Resources, and Animal Wealth (MANRAW).

During the latter part of the 1980s the civil war, which became much more intense beginning in 1988, led to a marked deterioration in Sudan's economic performance. This meant that ARC was starved of operating funds and staff salaries declined markedly in real terms. Its housing and research facilities also deteriorated to the point that it had serious difficulties in attracting and retaining qualified scientists.

### *The academic sector*

Tertiary level education in the agricultural sciences began in 1938 with the establishment of the Shambat School of Agriculture. In 1951 the school was merged with the Khartoum Veterinary School, the Gordon Memorial College, and various other tertiary education institutions to become the University College. In 1956, the University College was officially transferred to the University of Khartoum, which included a Faculty of Agriculture and a Faculty of Veterinary Medicine. About this time academic staff at both faculties began spending some of their time doing agricultural research. Nowadays research is the second principal responsibility of the Faculty of Agriculture (after teaching), but the infrastructure and funds made available to the faculty to conduct research are very limited. The Faculty of Veterinary Medicine (FVM) conducts research aimed at developing improved animal vaccines. The Institute of Environmental Studies (IES) was established in 1978 and is associated with the Faculty of Science. The Institute of Animal Production (IAP) was founded in 1982 and assumed the Department of Animal Production (previously part of the Faculty of Agriculture) and the Department of Animal Husbandry (previously part of the Faculty of Veterinary Medicine).

Although the number of students increased substantially during the 1960s and 1970s, the facilities at the University of Khartoum were insufficient to do all the training demanded. This led to the creation of a Faculty of Agricultural Sciences (FAS) at the University of Gezira (founded in 1976). Although the University of Gezira is a national university its research and training activities are mainly directed towards developing the Gezira Region in which the university is located.

The University of Juba was created in 1975. It includes a Faculty of Natural Resources and Environmental Studies (FNRES) which consists of four departments: biological and physical sciences, agriculture, forestry, and veterinary medicine. The faculty mainly teach and spend only limited amounts of time on research on natural resources and environmental issues.

The Khartoum Polytechnic University trains research technicians in the fields of agriculture, veterinary science, and forestry. Additional training of agricultural technicians is provided by the various institutes that were merged into a division within the College of Agricultural Studies of the Institute of Technical Colleges throughout the 1970s. Currently, each of the nine states in Sudan is in the process of developing its own university.

## **2.2 Present Structure**

The Agricultural Research Corporation (ARC), a semi-autonomous body which is directly responsible to the Ministry of Agriculture, Natural Resources, and Animal Wealth (MANRAW), is the principal agricultural research agency in Sudan. In 1991, ARC accounted for nearly half the country's agricultural research capacity in terms of full-time equivalent researchers (table 2). ARC directs most of its research towards crop production, but also does

Table 2: Overview of Present Structure of NARS, 1991

| Institutional category | Executing agency  |  |         | Research focus   | Staffed research sites <sup>a</sup> | Number of researchers |        |       |       |
|------------------------|---|--|---------|--|-------------------------------------|-----------------------|--------|-------|-------|
|                        | Supervising agency  | Name   | Acronym |  |                                     | National              | Expats | Total | FTEs  |
| Government             | Ministry of Agriculture, Natural Resources, and Animal Wealth | Agricultural Research Corporation                      | ARC     | crops, livestock, forestry, fisheries, range, wildlife | 32 (24)                             | 218                   | 0      | 218   | 218.0 |
|                        |   | Animal Production Research Administration              | APRA    | animal production                                      | 5 (5)                               | 31                    | 0      | 31    | 31.0  |
|                        |   | Veterinary Research Laboratories Administration        | VRLA    | animal health  | 7 (5)                               | 137                   | 0      | 137   | 137.0 |
| Academic               | University of Khartoum  | Faculty of Agriculture                                 | FA      | crops  | 1 (1)                               | 81                    | 0      | 81    | 4.1   |
|                        |   | Faculty of Veterinary Medicine                         | FVM     | animal health  | 1 (1)                               | 55                    | 0      | 55    | 16.5  |
|                        |   | Institute of Animal Production                         | IAP     | animal production                                      | 1 (1)                               | 15                    | 0      | 15    | 4.5   |
|                        |   | Institute of Environmental Studies                     | IES     | natural resources                                      | 1 (1)                               | 2                     | 0      | 2     | 1.8   |
|                        |   | Faculty of Natural Resources and Environmental Studies | FNRES   | natural resources                                      | 1 (1)                               | 36                    | 2      | 38    | 1.9   |
| University of Gezira   | Faculty of Agricultural Sciences                              | FAS  | crops   | 1 (1)  | 48                                  | 0                     | 48     | 9.6   |       |
|                        |   | <i>Total</i>   |         |  | 50 (40)                             | 623                   | 2      | 625   | 424.4 |

Source: 0999.

<sup>a</sup> Staffed with researchers and/or technicians. Bracketed sites are permanently staffed with researchers.

<sup>b</sup> Faculty staff include the departments of botany, chemistry, geology, physics, and zoology. The staff of the departments of botany and zoology totaled 34.

some research on livestock (animal feed), forestry, fisheries and marine biology, wildlife and range management, food processing, and natural resources. ARC is headquartered at Wad Medani. It consists of five regional stations, nine provincial stations, a sugar research station, plus four national research centers on food, forestry, wildlife, and fisheries. ARC also has a number of substations (about 13 in all) distributed throughout the various agroecological regions in the country.

Livestock research is the administrative responsibility of the Undersecretariat of Animal Resources of MANRAW. Two departments are responsible for livestock research: the Animal Production Research Administration (APRA) and the Veterinary Research Laboratories Administration (VRLA). APRA conducts research on pastures, fattening, and animal nutrition as well as the genetic improvement of sheep, dairy cattle, and specific indigenous cattle breeds. It is headquartered in Khartoum and supports five substations located throughout Sudan. VRLA's research activities are concentrated mainly on monitoring and researching issues related to animal health and the production of vaccines. VRLA consists of a Central Veterinary Research Laboratory at Soba, with several departments and supporting units each of which has specific responsibilities, and six State Veterinary Research Laboratories in those states with significant animal populations.

The Agricultural Research Council is one of the five sub-councils under the National Council of Research (NCR). It has a national coordinating role and disburses the government's contribution to agricultural research directly to individuals and multidisciplinary teams, as well as institutions.

The University of Khartoum, the University of Juba, and the University of Gezira have several faculties whose staff engage in some agricultural research. The Faculty of Agriculture (FA) at the University of Khartoum and the Faculty of Agricultural Sciences (FAS) at the University of Gezira focus most of their research on crops. The Faculty of Veterinary Medicine (FVM) and the Institute of Animal Production (IAP), both at the University of Khartoum, conduct research on animal health and production. Research on natural resource issues is conducted by the Institute of Environmental Studies (IES) of the University of Khartoum and the Faculty of Natural Resources and Environmental Studies (FNRES) of the University of Juba. The Departments of Botany and Zoology of the Faculty of Sciences within the University of Khartoum also engage in a small amount of agriculturally related research but are not included here because of lack of data.

Regional and international agricultural research organizations are excluded from table 2. The Arab Organization for Agricultural Development (AOAD) is headquartered in Khartoum. There are numerous CGIAR centers (e.g., ICARDA and ICRISAT) and donors that support agricultural research in Sudan in the form of multilateral and bilateral projects. The International Irrigation Management Institute (IIMI) is the only CGIAR center to maintain a permanently staffed (regional) office in Sudan.

The present organizational structures of ARC, APRA, VRDL, and the three Universities are provided in diagrammatic form in appendix 3.

### **3. NARS Statistics**

Questionnaire responses were received from ARC, APRA, VRLA, and various faculties within the three universities. They were combined with data and information from various secondary sources which are cited at the conclusion of this report.

As none of the institutes could report their actual expenditures on an annual basis, the expenditure data for ARC presented in this brief are based on government budget data as well as data from the World Bank regarding funding for agricultural research projects. ARC accounts for one half of the total full-time equivalent (FTE) researchers in the Sudanese NARS. Expenditure data for the other institutes were constructed by scaling their respective FTE researcher estimates by expenditure-per-researcher estimates based on ARC data on the presumption that ARC spending-per-scientist ratios are representative of the situation at these other institutes.

#### **3.1 Long-Term Development**

The number of agricultural researchers in the government sector of the Sudanese NARS grew substantial during the three decades since 1961, as did the number of researchers per million economically active agricultural population. In the early 1960s Sudan employed 15 FTE researchers per million economically active agricultural population which was about equivalent to the sub-Saharan African average in that period. By 1991 this ratio had grown to about 85 FTE researchers in the Sudan which was somewhat more than the corresponding regional average of 70 FTE researchers (Pardey, Roseboom, and Beintema 1995). For the period 1961-91 the number of FTE researchers grew at an annual rate of 8.4% which is higher than the corresponding annual rate of 6.4% for a sample of 16 sub-Saharan African countries.

Agricultural research expenditures in real terms grew slowly at only 1.5% per annum from 1961 to 1991. After a rapid growth during the 1960s and early 1970s, expenditures substantially declined in real terms during the past 15 years. A period which can be characterized by political instability, civil war in the South, major natural disasters, and economic decline. The overall growth rate of 1.5% per annum is substantial lower than the corresponding annual rate of 3.2% on average for a sample of 16 sub-Saharan African countries. Due to an exceptionally high rate of inflation Sudan's research expenditures have declined rapidly in real terms since 1980. Because research expenditures grew substantial slower than research staff, real spending per scientist in 1991 was only one sixth the —relatively high— level that prevailed during the early 1960s — a period during which major capital investments were made.

Agricultural research expenditures expressed as a percentage of agricultural GDP declined steadily after 1973 when it peaked at 0.91%. Since then it has trended down and by 1991 it had fallen by over half to reach 0.41%. In comparison, the regional average started at 0.58% in 1971, peaked at 0.84% in 1981 and declined to 0.55% in 1991 (Pardey, Roseboom, and Beintema 1995).

Table 3: *NARS Researcher and Expenditure Series, 1961-91*

|   | 1961-65 | 1966-70 | 1971-75 | 1976-80 | 1981-85 | 1986-90 | 1991   | growth rate <sup>a</sup><br>% |
|---|---------|---------|---------|---------|---------|---------|--------|-------------------------------|
| Researchers (FTEs)  | 52.2    | 76.4    | 166.1   | 247.6   | 327.0   | 357.5   | 424.4  | 8.4 <sup>a</sup>              |
| Expenditures (millions 1985 Sudanese Pounds)                          | 14.580  | 23.089  | 32.881  | 32.431  | 29.845  | 23.555  | 19.099 | 1.5 <sup>a</sup>              |
| Expenditures (millions 1985 PPP dollars) <sup>b</sup>                 | 16.462  | 26.070  | 37.126  | 36.618  | 33.698  | 26.596  | 21.463 | 1.5 <sup>a</sup>              |
| Expenditures per researcher (thousands 1985 PPP dollars) <sup>b</sup> | 314     | 350     | 230     | 148     | 103     | 75      | 51     | -6.4 <sup>a</sup>             |
| Number of economically active agricultural population (millions)      | 3.4     | 3.5     | 3.8     | 4.2     | 4.5     | 4.8     | 5.0    | 1.5 <sup>a</sup>              |
| Researchers per million econ. act. agr. population                    | 15.2    | 21.6    | 43.8    | 59.3    | 72.1    | 74.1    | 85.4   | 6.8 <sup>a</sup>              |
| AgGDP (millions 1985 PPP dollars) <sup>b</sup>                        | na      | na      | 4,257   | 5,225   | 5,285   | 5,157   | 4,646  | 1.0 <sup>c</sup>              |
| Expenditures as a % of AgGDP  | na      | na      | 0.77    | 0.65    | 0.57    | 0.45    | 0.41   | -3.1 <sup>c</sup>             |

Source: See appendices 5 and 6.

<sup>a</sup> Least squares growth rate for the 1961-91 period.

<sup>b</sup> For information on "PPP dollars" see appendix 2.

<sup>c</sup> Least squares growth rate for the 1970-91 period.

### 3.2 Human Resources

#### *Degree and Nationality Status of Researchers*

Table 4 presents a more detailed, long-run overview of developments concerning Sudan's agricultural research staff. Prior to political independence most of the country's agricultural research staff were expatriates. But, thereafter, the number of expatriate researchers declined to a negligible number by the mid-1970s and this situation has continued to the present.

The agricultural research staff developed steadily in terms of numbers and degree status. The growth in the number of researchers in the academic sector was not as substantial as the growth in the government sector during the period 1971-91.

Sudan is exceptionally well endowed with research staff holding postgraduate degrees when compared with other African countries. At present, just over one-half of Sudan's scientific staff hold PhDs. In the academic sector, over three quarters of the faculty have PhDs and no staff hold a BSC degree. All those holding a PhD received their degrees abroad; the three local universities do not provide training to PhD level. Although the universities award MSc degrees, most of the country's agricultural researchers obtained their MSc degree abroad. Given the inability of ARC to maintain the real salaries of scientists in the face of exceptionally high rates of inflation over recent years the corporation is finding it increasingly difficult to retain its high-qualified research staff.

Table 4: *Educational and Nationality Status of Researchers*

| Institutional category         | Researcher status | 1961-65     | 1966-70     | 1971-75      | 1976-80      | 1981-85      | 1986-90      | 1991         |
|--------------------------------|-------------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|
| <i>(full-time equivalents)</i> |                   |             |             |              |              |              |              |              |
| Government                     | PhD               | na          | na          | na           | 93.8         | 160.0        | 168.1        | 187.0        |
|                                | MSc               | na          | na          | na           | 62.8         | 88.4         | 111.3        | 140.0        |
|                                | BSc               | na          | na          | na           | 73.3         | 49.6         | 43.8         | 59.0         |
|                                | Subtotal          | 32.2        | 61.2        | 150.7        | 230.1        | 297.9        | 322.8        | 386.0        |
|                                | Expatriates       | 12.9        | 5.8         | 1.7          | 0.1          | 0            | 0            | 0            |
|                                | <i>Total</i>      | <i>45.1</i> | <i>67.1</i> | <i>152.4</i> | <i>230.0</i> | <i>297.9</i> | <i>322.8</i> | <i>386.0</i> |
| Academic                       | PhD               | na          | na          | na           | na           | 26.0         | 31.5         | 30.9         |
|                                | MSc               | na          | na          | na           | na           | 0.5          | 2.3          | 7.4          |
|                                | BSC               | na          | na          | na           | na           | 2.4          | 0.8          | 0            |
|                                | Subtotal          | 7.0         | 9.3         | 13.7         | 17.5         | 28.9         | 34.6         | 38.3         |
|                                | Expatriates       | 0.1         | 0.1         | 0.1          | 0.1          | 0.1          | 0.2          | 0.1          |
|                                | <i>Total</i>      | <i>7.1</i>  | <i>9.4</i>  | <i>13.8</i>  | <i>17.5</i>  | <i>29.1</i>  | <i>34.7</i>  | <i>38.4</i>  |
| Total                          | PhD               | na          | na          | na           | na           | 186.0        | 199.6        | 217.9        |
|                                | MSc               | na          | na          | na           | na           | 88.9         | 113.6        | 147.4        |
|                                | BSC               | na          | na          | na           | na           | 51.9         | 44.2         | 59.0         |
|                                | Subtotal          | 39.2        | 70.5        | 164.4        | 247.4        | 326.8        | 357.4        | 424.3        |
|                                | Expatriates       | 13.0        | 5.9         | 1.8          | 0.2          | 0.1          | 0.2          | 0.1          |
|                                | <i>Total</i>      | <i>52.2</i> | <i>76.4</i> | <i>166.1</i> | <i>247.6</i> | <i>327.0</i> | <i>357.5</i> | <i>424.4</i> |

Sources: See appendices 5 and 6.

### *Gender*

At present, 11.5% of the total agricultural research staff in Sudan are women, although the corresponding figure for the country's academic sector is only 3.9%. Of the governmental institutes, ARC, APRA, and VRLA have 9.2%, 36.0%, and 27.7% female researchers, respectively. The latter two percentages are high compared with other research institutes in Sudan.

### *Staff Composition*

Table 5 provides a detailed breakdown of the total permanent staff of the three government-sector institutes. In 1991 the number of technical support staff per researcher ranged from 1.3 for VRLA, 1.6 for APRA, and 2.7 for ARC. VRLA employs 3.4 other support staff (including administrative personnel) per researcher. For ARC and APRA the corresponding ratio is 13.8 and 17.0, respectively. The ratio of technical support staff per researcher and the ratio of other support staff per researcher were virtually unchanged during the late 1980s.

Table 5: Staffing Structure

| Staff category | ARC                          |      | APRA             |                  | VRLA    |      |
|----------------|------------------------------|------|------------------|------------------|---------|------|
|                | 1986-90                      | 1991 | 1986-90          | 1991             | 1987-90 | 1991 |
|                | <i>(number of personnel)</i> |      |                  |                  |         |      |
| Research staff | 203                          | 218  | 29               | 25               | 86      | 137  |
| Support staff  |                              |      |                  |                  |         |      |
| Technical      | 596                          | 590  | 46               | 46               | 198     | 172  |
| Administrative | 332                          | 304  |                  |                  | 32      | 49   |
| Other          | 2880                         | 2700 | 424 <sup>a</sup> | 424 <sup>a</sup> | 478     | 420  |
| Subtotal       | 3808                         | 3594 | 470              | 470              | 708     | 641  |
| Total          | 4011                         | 3812 | 499              | 495              | 794     | 778  |

Source: 0999

<sup>a</sup> "Other support" staff includes "administrative support" staff.

There is a wide variation in the number of researchers and technicians across stations and centers within ARC. Almost one half of ARC's total number of research scientists work at the Gezira Station and FRC. Most of the other stations and substations have rather limited numbers of research staff. The technician per researcher ratio also varies markedly across the various research sites. In 1991 the technical staff per researcher ratio ranged from less than one at the Obeid Research Station to almost seven technicians per researcher at the Gezira Research Station. The educational attainment of most of the technicians is poor. Most have only secondary or intermediate school education (56% and 21%, respectively). Only 10% of the technical staff hold post-secondary school diplomas, but many of these individuals now perform administrative rather than technical functions.

### 3.3 Financial Resources

Table 6 gives a breakdown of agricultural spending by institutional category. No semi-public research institutes operate within Sudan. The share of the universities in total expenditures ranged from 7% to 13% during the period 1961-91.

Table 6: Agricultural Research Expenditures

| Institutional category | 1961-65   | 1966-70 | 1971-75 | 1976-80 | 1981-85 | 1986-90 | 1991   |
|------------------------|---|---------|---------|---------|---------|---------|--------|
|                        | <i>(millions 1985 Sudanese pounds per year)</i> |         |         |         |         |         |        |
| Government             | 12.596  | 20.204  | 30.123  | 30.126  | 27.236  | 21.260  | 17.291 |
| Semi-public            | 0   | 0       | 0       | 0       | 0       | 0       | 0      |
| Academic               | 1.984   | 2.885   | 2.759   | 2.304   | 2.608   | 2.295   | 1.718  |
| Total                  | 14.580  | 23.089  | 32.881  | 32.431  | 29.845  | 23.555  | 19.009 |
|                        | <i>(millions 1985 PPP dollars per year)</i>     |         |         |         |         |         |        |
| Total                  | 16.462  | 26.070  | 37.126  | 36.618  | 33.698  | 26.596  | 21.463 |

Source: See appendix 5.

### *Factor Mix*

Table 7 provides a breakdown of ARC's total government budget (i.e., excluding donor funds) by cost category for the period 1961-91. The average share of salaries in the total budget increased substantially during the past three decades climbing from 46% in the late 1960s to 75% in the early 1980s. Within the salaries component of the budget 24% goes to salaries of scientists, 47% to labor (e.g., field) staff, 20% to technical staff, and 8% to clerical staff.

Table 7: *Cost Categories of Government Budget, ARC*

| Cost category            | 1961-65              | 1966-70    | 1971-75    | 1976-80    | 1981-85    | 1986-90    | 1991       |
|--------------------------|----------------------|------------|------------|------------|------------|------------|------------|
|                          | <i>(percentages)</i> |            |            |            |            |            |            |
| Salaries                 | 51.4                 | 45.7       | 53.8       | 71.8       | 75.1       | 74.7       | 72.8       |
| Operating                | 42.2                 | 50.0       | 28.0       | 17.3       | 15.2       | 12.1       | 13.9       |
| Development <sup>a</sup> | 6.4                  | 4.3        | 18.2       | 10.9       | 9.7        | 13.2       | 13.3       |
| <i>Total</i>             | <i>100</i>           | <i>100</i> | <i>100</i> | <i>100</i> | <i>100</i> | <i>100</i> | <i>100</i> |

Source: 252, 445, 1310, 1542, and 1544.

<sup>a</sup> According to Abdallah et al. (n.d.) this budget item is used to fund new projects and further support of existing projects. Presumably it can include salaries, operating and capital costs.

The share of total costs committed to operational expenses declined substantially from 42% in the early 1960s to 14% in 1991. The operational budget per scientist varies tremendously between the various stations and centers within ARC. The budget item labeled "development costs" fluctuated throughout this period and ranged from a low of 2.7% in 1967 to 13.3% in 1991.

Since the early 1980s ARC certainly has lacked adequate operating and capital funds and become increasingly reliant on external funds to carry out its research activities. However, despite its larger share in total expenditures, salaries have declined in real terms as well. If donor support had been included in table 7 the share of operational and development costs would have increased substantially because most of this financial support went to operational and capital expenditures (Abdallah et al., n.d.).

### *Sources of Funds*

An overview of ARC's major sources of funding is presented in table 8. ARC receives funds from five different sources: national government budget, contributions from public-sector agricultural operations (as the Gezira, Rabad, and New Halfa irrigation schemes as well as sugar and cotton companies), funds from external sources, testing fees for agrochemicals, and revenues from the sale of farm products. The external funds include operational costs in specific fields of research, as well as funds for capital investments on such things as vehicles and laboratory equipment (Abdallah et al., n.d.). However, no data were available on testing fees and revenues from sales, but these two items probably account only for a minor share of the total funds available.

Table 8: *Sources of Funds for ARC*

| Source of funding            | 1961-65      | 1966-70    | 1971-75    | 1976-80    | 1981-85    | 1986-90    | 1991       |
|------------------------------|--------------|------------|------------|------------|------------|------------|------------|
|                              | (percentage) |            |            |            |            |            |            |
| Government                   | 83.2         | 88.1       | 90.0       | 84.0       | 71.7       | 62.8       | 51.1       |
| Internal donors <sup>a</sup> | 16.8         | 11.0       | 4.0        | 8.2        | 5.8        | 1.7        | 3.4        |
| World Bank <sup>bc</sup>     | 0            | 0          | 0.3        | 7.8        | 22.5       | 35.5       | 45.5       |
| <i>Total</i>                 | <i>100</i>   | <i>100</i> | <i>100</i> | <i>100</i> | <i>100</i> | <i>100</i> | <i>100</i> |

Source: 999.

<sup>a</sup> Internal donors include the contributions of the government production schemes, as well as those of the cotton and sugar companies.

<sup>b</sup> No information on financial support was available for USAID and other donors.

<sup>c</sup> World Bank contributions per year are derived by dividing the total expenditures of the research component of each project by the duration of each project in months.

Only data on donor support from the World Bank, the main donor in Sudan, were available. USAID funded two agricultural research projects (of which one was in cooperation with the World Bank) in the past two decades. However, USAID support stopped after 1985 because of deteriorating relations between Sudan and the USA. In the past, ARC also received financial support from DANIDA, FINIDA, UNDP, IFAD, and the Dutch government. Of late also the relations with these other Western donors have been problematic (Europa Publications Ltd 1994). No detailed information could be obtained on donor support other than the World Bank.

Most of the World Bank projects began in the late 1970s and early 1980s. As a consequence, the share of World Bank support increased from 0.3% in the early 1970s to almost one half of ARC's total sources of funds in 1991. It seems that most of the World Bank's projects ended in the early 1990s and as no new projects were started the amount of external funding (i.e., World Bank funds) declined in the years following 1991.

### 3.4 Research Focus

An overview of the research focus of the Sudanese NARS is provided in table 9. University research staff have been roughly allocated based on their institutional affiliation. In 1991 crop and livestock research received roughly equal attention (38.1% and 35.5%, respectively). All of the researchers at APRA worked on livestock and animal production issues. Roughly two-thirds of the VRLA researchers worked on livestock. The other one-third of the researchers worked on "other" issues (e.g., biotechnology, entomology, and biological product services). ARC researchers worked on a broad range of agricultural problems. Within crop research most of the attention is given to research on irrigated production systems, with cotton being the major crop. Since the initiation of WSARP, however, Sudan's agricultural research agenda has broadened to include an increasing amount of research on other commodities such as wheat, groundnuts, and sorghum.

Table 9: *Research Focus, 1991*<sup>a</sup>

| Research focus    | ARC          |            | APRA        |            | VRLA         |            | Universities |            | Total        |            |
|-------------------|--------------|------------|-------------|------------|--------------|------------|--------------|------------|--------------|------------|
|                   | FTE          | Share      | FTE         | Share      | FTE          | Share      | FTE          | Share      | FTE          | Share      |
|                   |              | %          |             | %          |              | %          |              | %          |              | %          |
| Crop              | 148.0        | 67.9       | 0           | 0          | 0            | 0          | 13.7         | 35.7       | 161.7        | 38.1       |
| Livestock         | 9.3          | 4.3        | 31.0        | 100        | 89.2         | 65.1       | 21.0         | 54.7       | 150.5        | 35.5       |
| Forestry          | 14.4         | 6.6        | 0           | 0          | 0            | 0          | 0            | 0          | 14.4         | 3.4        |
| Fisheries         | 13.4         | 6.1        | 0           | 0          | 0            | 0          | 0            | 0          | 13.4         | 3.2        |
| Natural resources | 4.1          | 1.9        | 0           | 0          | 0            | 0          | 3.7          | 9.6        | 7.8          | 1.8        |
| Other             | 28.8         | 13.2       | 0           | 0          | 47.8         | 34.9       | 0            | 0          | 76.6         | 18.0       |
| <i>Total</i>      | <i>218.0</i> | <i>100</i> | <i>31.0</i> | <i>100</i> | <i>137.0</i> | <i>100</i> | <i>38.4</i>  | <i>100</i> | <i>424.4</i> | <i>100</i> |

Source: 999

Note: The “natural resources” and “other” categories include research that could not otherwise be allocated to a specific commodity or commodity group. The natural resource category refers to unallocatable soils, land use, and water research.

<sup>a</sup> Research shares for ARC, APRA, and VRLA were available for 1992, 1993, and 1989, respectively. These shares were used to prorate the 1991 FTE figures reported in this table.

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This bibliography comprises three different sets of references. The “references” section relates to references cited in the text, the “data sources” to references from which data have been extracted to construct the time series (see appendices 5 and 6), and “other references” to references that have been consulted in the process of data collection but not used explicitly.

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## Appendix 1: Country background information



### Geography

Area: 250.6 million ha

Location: Northeastern Africa. It borders to the north on Egypt, to the east on Ethiopia and the Red Sea, to the west on the Central African Republic, Chad and Libya, and to the south on Kenya, Uganda and Zaire.

Agroecological features: the Sudan is comprised of an immense plain with the rock desert of the Sahara in the North; an area of undulating sand dunes in the west; and a clay plain with enormous swamps and isolated mountains in the south and central parts. The Red Sea region in the east is hilly (average elevation 2,000 m above sea level), and there are massive mountain ranges with peaks such as mount Kinyeti along the Ugandan border in the south. The Nile is the principal river, meandering through the country south to north.

Climate ranges from a tropical continental type in the northern desert region to equatorial in the southern part. Average summer (April-July) temperatures vary from 32NC in the south to 37NC in the central part, and winter temperatures from 17NC to 29NC. Annual rainfall varies from almost nothing in the north to more than 1,400 mm in the extreme south, where the rainy season lasts eight or nine months (April-November).

Vegetation gradually increases north to south from the desert in the north to the semiarid shrub and savanna of the central south, to tropical rain forests in the uplands of the south; date palms line the banks of the Nile.

### Population

Total (1991): 25.8 million

Annual growth rate (1981-90)<sup>a</sup>: 2.7%

Literacy (1990): 27.1%

Life expectancy (1991): 51 years

### Economy (values reported in 1985 PPP dollars)

Gross Domestic Product (1991): 22,318 million dollars

Per capita GDP (1991): 864 dollars

Agricultural GDP (1991): 5,528 million dollars

Share of agriculture in GDP (1991): 24.8%

Annual growth rates (1981-90)<sup>a</sup>

GDP: 0.2%

GDP per capita: -2.5%

AgGDP: -0.8%

### Trade (values reported in current dollars)

Net surplus total trade (1991): -890 million dollars

Net surplus agricultural trade (1991): 111 million dollars

Percentage of agricultural imports in total imports: 24.7%

Percentage of agricultural exports in total exports: 96.6%

Major agricultural import commodities (1991)<sup>b</sup>: palm oil (25%), wheat flour (20%), dry milk (10%), tea (8%) and rice (7%)

Major agricultural export commodities (1991)<sup>b</sup>: bovine cattle (58%), cotton lint (24%) and sesame seed (11%)

### Agriculture

Agricultural land (1990): 122.9 million ha

Annual growth rate (1981-90)<sup>a</sup>: 1.4%

Percentage arable: 10.4%

Percentage permanent crop: 0.1%

Percentage permanent pastures: 89.5%

Percentage irrigated arable and permanent cropland: 14.7%

Economically active agricultural population (1991): 5.0 million

Annual growth rate (1981-90)<sup>a</sup>: 1.2%

Percentage in total economically active population: 59.1%

Fertilizer use per ha arable land (1990): 6.3 kg

Annual growth rate (1981-90)<sup>a</sup>: -1.4%

Major crops (in decreasing order of value of production): sorghum, sesameseed, groundnuts, wheat, cotton lint and sugar cane

Sources: Europa Publications (1992), FAO (1993), and World Bank (1993).

<sup>a</sup> Least squares growth rate.

<sup>b</sup> Bracketed percentages represent value share of the respective total.

## Appendix 2: Definitions and concepts

### NARS

The construction of quantitative and internationally comparable expenditure, personnel, and related measures of a national agricultural research system (NARS) requires a precise idea of what, in fact, is being measured. Since the term NARS is subject to a variety of interpretations, it is necessary to define rather precisely the NARS concept used here. Our approach adheres, wherever possible, to the internationally accepted statistical procedures and definitions developed by the OECD and UNESCO for compiling R&D statistics (OECD 1981 and UNESCO 1984). For statistical purposes a NARS is defined in terms of the following characteristics:

(a) *National*. The concept of a “national” system used in this report refers to domestically targeted research activities funded and/or executed by the *public* sector of a particular country. A relatively broad concept of the public sector is taken to include government, semi-public, and academic research institutes. However, private, for-profit research as well as the research activities of supranational research agencies that are not executed through national institutes are excluded. Also excluded is research undertaken by short-term development projects.

(b) *Agricultural*. Agricultural research, as defined here, includes crop, livestock, forestry, and fisheries research, as well as research on agricultural inputs, the natural resource base, and socio-economic aspects of primary agricultural production. It excludes, where possible, research concerning the off-farm storage and processing of agricultural products, commonly referred to as post-harvest research and food-processing research. This delineation corresponds with the national accounts definition of the agricultural sector.

(c) *Research*. Research is often performed in conjunction with other activities such as extension, education, and production. To the extent possible, research activities (in terms of expenditures and staff) are differentiated from these other activities. However, if non-research activities were an integral part of an institute’s research activities and accounted for less than 20% of the resources of the institute, it was expedient to classify all the activities of the institute as being research-related.

### Full-Time Equivalent (FTE)

A full-time equivalent researcher year is taken to be a person who holds a full-time position as a researcher during the whole year. Adjustments to full-time equivalents have only been made when: (a) a research position was part-time; (b) a research position was not filled for the whole year; or (c) if the position explicitly involved

tasks other than agricultural research. In the latter case an estimate was made of the time spent on agricultural research. No adjustments were made, however, for vacation or sick leave nor for time spent on administration, meetings, travel or other activities that form part of the normal duties required to support a research endeavor. Following this line of reasoning, professional staff in management positions were classified as researchers.

The degree status of researchers is determined on the following basis: 3-4 years full-time university education (BSc), 5-6 years (MSc), and more than 6 years plus doctorate thesis (PhD).

### Expatriate Researcher Costs

Many expatriate researchers working on donor-supported projects in NARSs are paid their salaries and living expenses directly by the donor agency. All (or some substantial fraction) of these costs do not get included in the financial reports of the agricultural research organizations. To calculate these *implicit* costs we took the average cost per researcher in 1985 to be 120,000 “1985 PPP dollars” and backcast this figure using the rate of change in real personnel costs per FTE researcher in the US state agricultural experiment station system. This extrapolation procedure makes the assumption that the personnel-cost trend for US researchers is a reasonable proxy of the trend in real costs of internationally recruited staff working in NARSs. Unless otherwise stated, FTE expatriate researchers were costed at \$80,000 “1985 PPP dollars” per researcher for the 1961-65 period, \$85,000 per researcher for 1966-70, \$90,000 per researcher for 1971-75, \$110,000 per researcher for 1976-80, and \$120,000 per researcher for 1981-91.

### Deflators and Exchange Rates

All expenditure figures were first compiled in current local currency units (appendix 5). In order to facilitate comparisons over time and across countries these figures are deflated with a local GDP deflator to base year 1985, and then converted to a common currency (US dollars) using the 1985 purchasing power parity (PPP) over GDP. PPPs are synthetic exchange rates that attempt to reflect the purchasing power of a country’s currency. The PPPs used here are derived from the Penn World Table (Mark 5), which is based on the benchmark studies of the International Comparison Project (Summers and Heston 1991). For additional information on currency conversion methods in this context see Pardey, Roseboom, and Craig (1992).

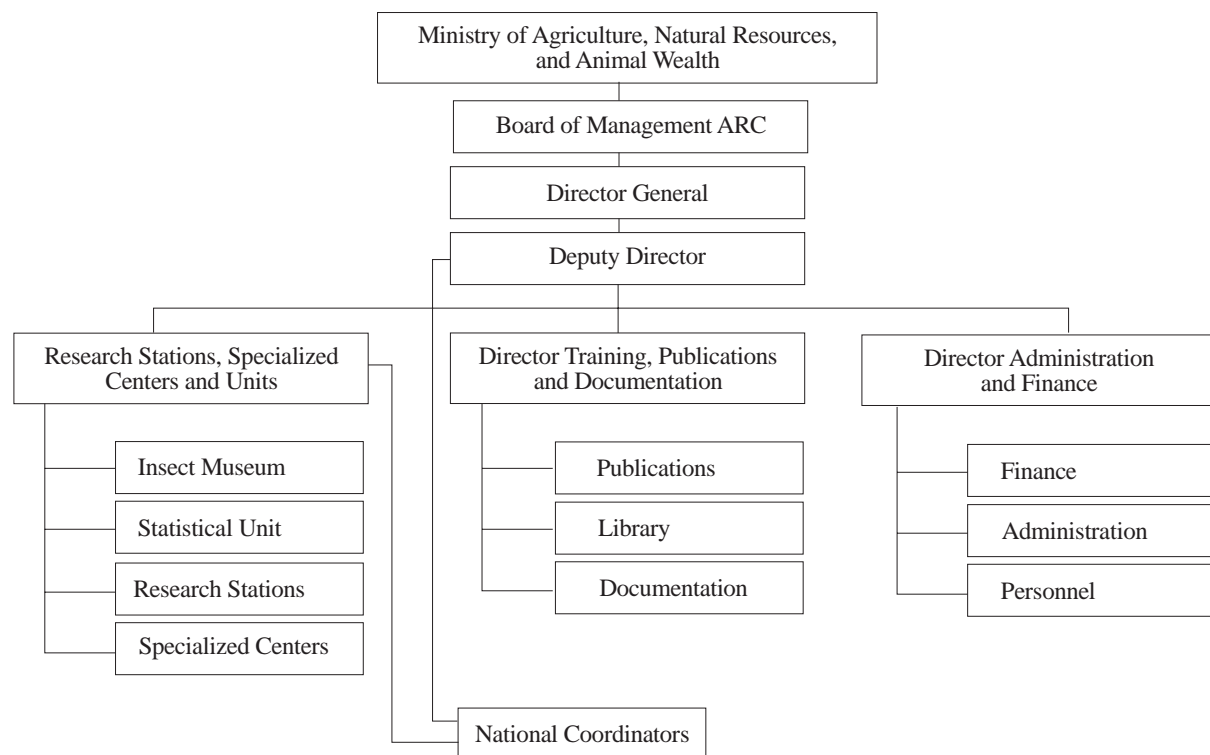
*Nomenclature for tables in text*

A zero indicates an actual observation of zero, a dash indicates an observation is not relevant (due to institutional mergers, closures, and so on), while “na” indicates an observation that is not available.

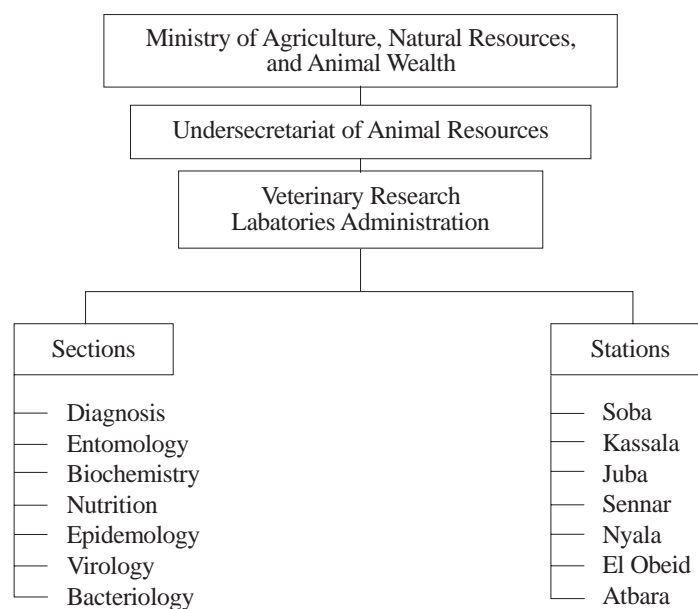
In the text we note any marked deviations from these data compilation norms and include points of clarification if warranted.

### Appendix 3: Organizational charts of the agricultural research institutes

#### *Agricultural Research Corporation*

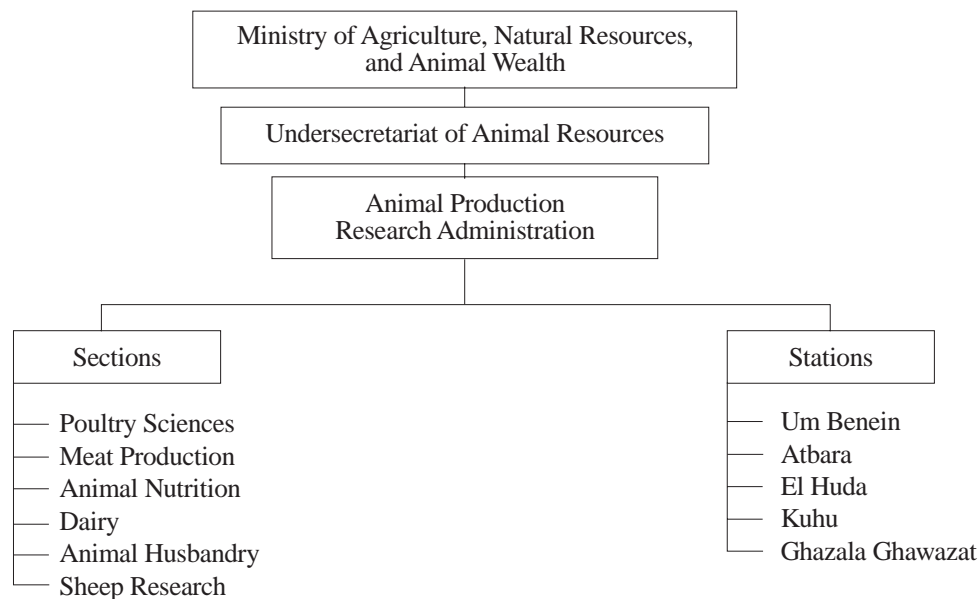


#### *Veterinary Research Laboratories Administration*

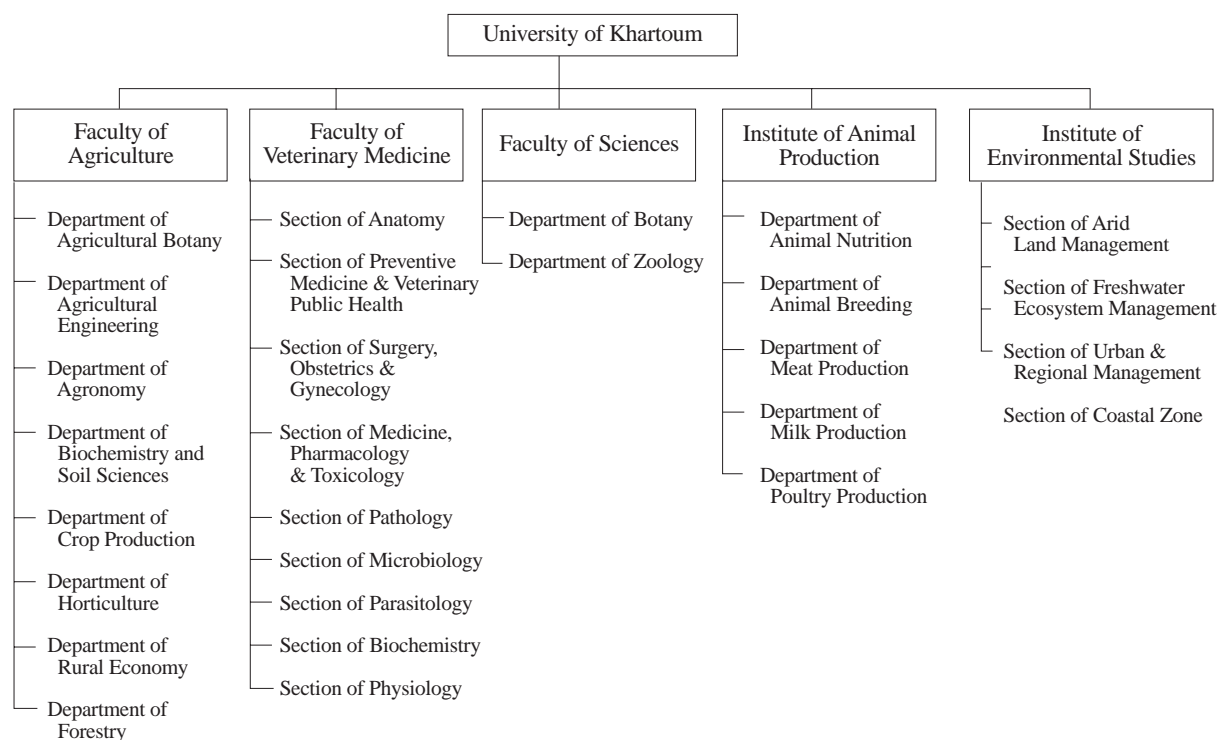


### Appendix 3: Organizational charts of the agricultural research institutes (contd.)

#### Animal Production Research Administration

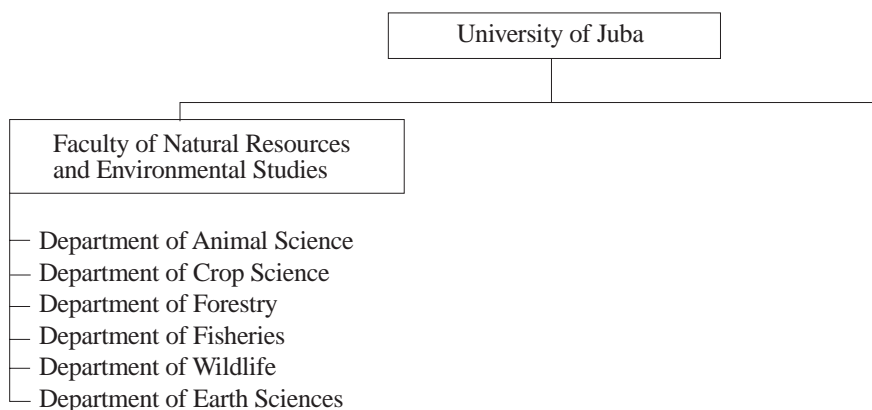


#### University of Khartoum

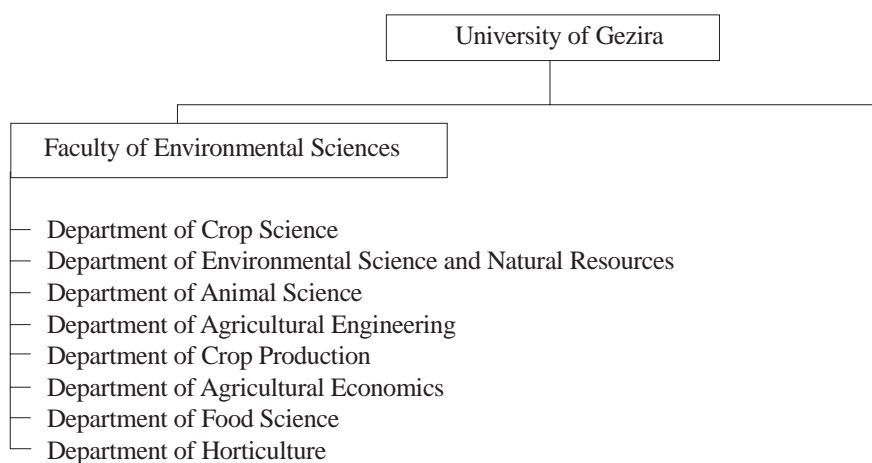


### Appendix 3: Organizational charts of the agricultural research institutes (contd.)

#### University of Juba



#### University of Gezira



#### **Appendix 4: Addresses of the agricultural research institutes**

Ministry of Agriculture and Natural Resources  
P.O. 285  
Khartoum  
SUDAN

Director General  
Agricultural Research Corporation  
P.O. Box 126  
Wad Medani  
SUDAN

Director  
Animal Production Research Administration  
P.O. Box 34  
Khartoum  
SUDAN

Director  
Veterinary Research Laboratories Administration  
P.O. Box 293  
Khartoum  
SUDAN

Faculty of Agriculture  
University of Khartoum  
P.O. Box 321  
Shambat, Khartoum North  
SUDAN

Faculty of Science  
University of Khartoum  
P.O. Box 321  
Shambat, Khartoum North  
SUDAN

Faculty of Veterinary Medicine  
University of Khartoum  
P.O. Box 321  
Shambat, Khartoum North  
SUDAN

Institute of Animal Production  
University of Khartoum  
P.O. Box 321  
Shambat, Khartoum North  
SUDAN

Institute of Environmental Studies  
University of Khartoum  
P.O. Box 321  
Shambat, Khartoum North  
SUDAN

Faculty of Natural Resources and Environmental  
Studies  
University of Juba  
P.O. Box 82  
Juba, Equatoria  
SUDAN

Faculty of Agricultural Sciences  
University of Gezira  
P.O. Box 20  
Wad Medani  
SUDAN

**Appendix 5: Researchers and research expenditure totals, 1961-91**

| Total Number of FTE Researchers |                     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |  |  |  |  |
|---------------------------------|---------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|--|--|--|
| Name country: Sudan             |                     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |  |  |  |  |
| Category                        | Name institute      | 1961  | 1962  | 1963  | 1964  | 1965  | 1966  | 1967  | 1968  | 1969  | 1970  | 1971  | 1972  | 1973  | 1974  | 1975  | 1976  |  |  |  |  |
| Government                      | ARC                 | 41.8  | 43.4  | 45    | 46.8  | 48.5  | 50.2  | 52    | 62.0  | 72.0  | 82    | 94.0  | 106.0 | 118.0 | 130.0 | 142.0 | 154.0 |  |  |  |  |
|                                 | VRLA                | —     | —     | —     | —     | —     | —     | —     | —     | —     | 17    | 19.6  | 22.1  | 27.3  | 29.9  | 32.4  |       |  |  |  |  |
|                                 | APRA                | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | 0     | 4.8   | 9.7   | 14.5  | 19.3  | 24.2  |  |  |  |  |
| Government subtotal             |                     | 41.8  | 43.4  | 45.0  | 46.8  | 48.5  | 50.2  | 52.0  | 62.0  | 72.0  | 99.0  | 113.6 | 133.0 | 152.4 | 171.8 | 191.2 | 210.6 |  |  |  |  |
|                                 | Academic            | 0.8   | 0.9   | 1.1   | 1.2   | 1.4   | 1.6   | 1.7   | 1.9   | 2.0   | 2.2   | 2.1   | 2.0   | 2.0   | 2.2   | 2.4   | 2.6   |  |  |  |  |
|                                 | FA-UK               | 5.4   | 5.7   | 6.0   | 6.3   | 6.6   | 6.9   | 7.2   | 7.5   | 7.8   | 8.1   | 9.5   | 10.9  | 12.3  | 12.6  | 12.8  | 13.1  |  |  |  |  |
|                                 | FVM-UK              | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     |  |  |  |  |
|                                 | IAP-UK              | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     | —     |  |  |  |  |
| Academic subtotal               |                     | 6.2   | 6.6   | 7.1   | 7.5   | 8.0   | 8.5   | 8.9   | 9.4   | 9.8   | 10.3  | 11.6  | 12.9  | 14.2  | 14.7  | 15.2  | 15.7  |  |  |  |  |
|                                 | Total               | 48.0  | 50.0  | 52.1  | 54.3  | 56.5  | 58.7  | 60.9  | 71.4  | 81.8  | 109.3 | 125.2 | 145.9 | 166.6 | 186.5 | 206.4 | 226.3 |  |  |  |  |
|                                 | Sources:            |       |       | 852   |       |       |       | 10    |       |       | 175;  |       |       | 888   |       |       |       |  |  |  |  |
|                                 |                     |       |       |       |       |       |       |       |       |       | 532   |       |       |       |       |       |       |  |  |  |  |
|                                 |                     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |  |  |  |  |
| Government                      | Name institute      | 1977  | 1978  | 1979  | 1980  | 1981  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  | 1991  | 1992  |  |  |  |  |
|                                 | ARC                 | 166   | 163.5 | 161   | 164   | 218   | 200   | 202   | 202.0 | 202   | 202   | 202   | 202   | 218   | 218   | 218   | 218   |  |  |  |  |
|                                 | VRLA                | 35    | 40.1  | 45.2  | 50.3  | 55.4  | 60.5  | 65.6  | 70.7  | 75.8  | 80.9  | 86    | 86    | 86    | 86    | 86    | 137   |  |  |  |  |
|                                 | APRA                | 29    | 28.8  | 28.5  | 28.2  | 28.0  | 27.8  | 27.5  | 27.2  | 27    | 27    | 27    | 31    | 31    | 31    | 31    | 31    |  |  |  |  |
|                                 | Government subtotal | 230.0 | 232.4 | 234.7 | 242.6 | 301.4 | 288.2 | 295.1 | 300.0 | 304.8 | 309.9 | 315.0 | 319.0 | 335.0 | 335.0 | 335.0 | 386.0 |  |  |  |  |
|                                 | Academic            | 2.8   | 3.1   | 3.3   | 3.5   | 3.7   | 4.0   | 4.0   | 4.1   | 4.2   | 4.2   | 4.2   | 4.2   | 4.0   | 4.0   | 4.0   | 4.0   |  |  |  |  |
|                                 | FA-UK               | 13.4  | 13.6  | 13.9  | 14.2  | 14.4  | 14.7  | 14.9  | 15.1  | 15.3  | 15.3  | 15.3  | 14.4  | 14.4  | 16.5  | 16.5  | 16.5  |  |  |  |  |
|                                 | FVM-UK              | —     | —     | —     | —     | —     | 1.3   | 2.6   | 3.8   | 5.1   | 5.1   | 5.1   | 5.1   | 5.1   | 4.5   | 4.5   | 4.5   |  |  |  |  |
|                                 | IAP-UK              | —     | —     | 0.2   | 0.4   | 0.7   | 0.9   | 1.1   | 1.1   | 1.3   | 1.8   | 1.8   | 1.8   | 1.8   | 1.8   | 1.8   | 1.8   |  |  |  |  |
|                                 | FNS-UJ              | 0.2   | 0.5   | 0.7   | 1.2   | 1.6   | 2.1   | 2.1   | 1.9   | 1.6   | 1.4   | 1.4   | 1.4   | 1.4   | 1.9   | 1.9   | 1.9   |  |  |  |  |
| Academic subtotal               |                     | 0.1   | 0.2   | 0.3   | 0.4   | 2.1   | 3.9   | 5.6   | 5.9   | 6.2   | 6.5   | 6.8   | 7.1   | 7.4   | 8.0   | 9.6   |       |  |  |  |  |
|                                 | FA-UK               | 16.5  | 17.4  | 18.4  | 19.7  | 22.6  | 26.8  | 30.1  | 31.9  | 34.0  | 34.3  | 34.6  | 34.0  | 34.0  | 36.8  | 38.4  |       |  |  |  |  |
|                                 | Total               | 246.5 | 249.7 | 253.1 | 262.2 | 324.0 | 315.0 | 325.2 | 331.9 | 338.8 | 344.2 | 349.6 | 353.0 | 369.0 | 371.8 | 424.4 |       |  |  |  |  |
|                                 | Sources:            | 252   |       | 251;  | 73    | 251   | 250;  | 76    |       |       | 999   | 999   | 999   | 999   | 999   | 999   | 999   |  |  |  |  |
|                                 |                     |       |       | 888   |       |       | 979   |       |       |       |       |       |       |       |       |       |       |  |  |  |  |

**Appendix 5: Researchers and research expenditure totals, 1961-91 (contd.)**

| Total Research Expenditures       |                | Currency: million Sudanese Pounds |        |        |        |        |        |        |        |        |        |        |                      |                 |                 |                 |                 |
|-----------------------------------|----------------|-----------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------------------|-----------------|-----------------|-----------------|-----------------|
| Name country: Sudan               | Name institute | 1961                              | 1962   | 1963   | 1964   | 1965   | 1966   | 1967   | 1968   | 1969   | 1970   | 1971   | 1972                 | 1973            | 1974            | 1975            | 1976            |
| Government                        | ARC            | 0.444                             | 0.498  | 0.595  | 0.715  | 0.756  | 0.936  | 1.042  | 1.099  | 1.226  | 1.496  | 1.632  | 1.928                | 2.209           | 2.698           | 2.785           | 2.812           |
|                                   | URLA           | —                                 | —      | —      | —      | —      | —      | —      | —      | —      | 0.310  | 0.340  | 0.403                | 0.463           | 0.566           | 0.585           | 0.592           |
|                                   | APRA           | —                                 | —      | —      | —      | —      | —      | —      | —      | —      | —      | 0      | 0.088                | 0.181           | 0.301           | 0.379           | 0.441           |
| Government subtotal               |                | 0.444                             | 0.498  | 0.595  | 0.715  | 0.756  | 0.936  | 1.042  | 1.099  | 1.226  | 1.807  | 1.971  | 2.419                | 2.853           | 3.565           | 3.749           | 3.845           |
| Academic                          | FA-UK          | 0.008                             | 0.010  | 0.014  | 0.019  | 0.022  | 0.029  | 0.034  | 0.033  | 0.035  | 0.040  | 0.037  | 0.037                | 0.037           | 0.045           | 0.047           | 0.048           |
|                                   | FVM-UK         | 0.057                             | 0.065  | 0.079  | 0.096  | 0.103  | 0.128  | 0.144  | 0.133  | 0.133  | 0.148  | 0.165  | 0.198                | 0.230           | 0.261           | 0.252           | 0.239           |
|                                   | IAP-UK         | —                                 | —      | —      | —      | —      | —      | —      | —      | —      | —      | —      | —                    | —               | —               | —               | —               |
|                                   | IES-UK         | —                                 | —      | —      | —      | —      | —      | —      | —      | —      | —      | —      | —                    | —               | —               | —               | —               |
|                                   | FNS-UJ         | —                                 | —      | —      | —      | —      | —      | —      | —      | —      | —      | —      | —                    | —               | —               | —               | —               |
|                                   | FA-UG          | —                                 | —      | —      | —      | —      | —      | —      | —      | —      | —      | —      | —                    | —               | —               | —               | —               |
| Academic subtotal                 |                | 0.065                             | 0.076  | 0.094  | 0.115  | 0.125  | 0.157  | 0.179  | 0.166  | 0.167  | 0.188  | 0.202  | 0.235                | 0.267           | 0.306           | 0.299           | 0.287           |
| Total (current LCU)               |                | 0.510                             | 0.574  | 0.689  | 0.830  | 0.881  | 1.093  | 1.220  | 1.266  | 1.393  | 1.994  | 2.173  | 2.654                | 3.119           | 3.871           | 4.048           | 4.132           |
| GDP deflator (1985=100)           |                | 4.4                               | 4.8    | 4.6    | 4.8    | 5.1    | 5.2    | 5.8    | 5.9    | 6.1    | 6.9    | 7.0    | 7.8                  | 9.2             | 11.6            | 12.5            | 12.9            |
| Total (constant 1985 LCU)         |                | 11.507                            | 11.934 | 15.054 | 17.153 | 17.251 | 21.073 | 21.145 | 21.405 | 23.010 | 28.813 | 30.941 | 33.811               | 33.912          | 33.339          | 32.403          | 32.022          |
| Total (constant 1985 PPP dollars) |                | 12.992                            | 13.475 | 16.998 | 19.368 | 19.479 | 23.793 | 23.875 | 24.168 | 25.981 | 32.533 | 34.936 | 38.176               | 38.290          | 37.643          | 36.587          | 36.156          |
| Sources:                          |                | 1542                              | 1542   | 1542   | 1542   | 1542   | 1542   | 1542   | 1542   | 1544   | 1544   | 1544   | 252; 448; 1544; 1474 | 252; 1544       | 252; 1544       | 252; 1544       | 252; 1544       |
| Category                          | Name institute | 1977                              | 1978   | 1979   | 1980   | 1981   | 1982   | 1983   | 1984   | 1985   | 1986   | 1987   | 1988                 | 1989            | 1990            | 1991            | 1992            |
| Government                        | ARC            | 3.003                             | 3.337  | 3.729  | 7.397  | 7.894  | 8.685  | 10.189 | 12.236 | 14.094 | 16.847 | 33.481 | 37.798               | 47.549          | 80.591          | 116.014         |                 |
|                                   | URLA           | 0.633                             | 0.818  | 1.047  | 2.269  | 2.006  | 2.627  | 3.309  | 4.283  | 5.289  | 6.747  | 14.254 | 16.092               | 18.758          | 31.793          | 72.908          |                 |
|                                   | APRA           | 0.525                             | 0.587  | 0.660  | 1.274  | 1.014  | 1.205  | 1.387  | 1.651  | 1.884  | 2.252  | 4.475  | 5.801                | 6.762           | 11.460          | 16.497          |                 |
| Government subtotal               |                | 4.160                             | 4.742  | 5.437  | 10.940 | 10.913 | 12.518 | 14.884 | 18.170 | 21.266 | 25.846 | 52.211 | 59.690               | 73.068          | 123.843         | 205.420         |                 |
| Academic                          | FA-UK          | 0.051                             | 0.062  | 0.076  | 0.158  | 0.135  | 0.172  | 0.203  | 0.249  | 0.293  | 0.350  | 0.696  | 0.786                | 0.883           | 1.487           | 2.155           |                 |
|                                   | FVM-UK         | 0.242                             | 0.278  | 0.322  | 0.639  | 0.523  | 0.638  | 0.752  | 0.915  | 1.067  | 1.276  | 2.536  | 2.694                | 3.141           | 6.100           | 8.781           |                 |
|                                   | IAP-UK         | —                                 | —      | —      | —      | —      | 0.055  | 0.129  | 0.232  | 0.356  | 0.425  | 0.845  | 0.954                | 0.982           | 1.664           | 2.395           |                 |
|                                   | IES-UK         | —                                 | —      | 0.005  | 0.020  | 0.024  | 0.039  | 0.057  | 0.082  | 0.126  | 0.150  | 0.298  | 0.337                | 0.393           | 0.665           | 0.958           |                 |
|                                   | FNS-UJ         | 0.004                             | 0.010  | 0.016  | 0.053  | 0.059  | 0.091  | 0.094  | 0.099  | 0.098  | 0.117  | 0.232  | 0.262                | 0.414           | 0.702           | 1.011           |                 |
|                                   | FA-UG          | 0.002                             | 0.004  | 0.007  | 0.018  | 0.077  | 0.168  | 0.282  | 0.357  | 0.433  | 0.542  | 1.127  | 1.329                | 1.614           | 2.957           | 5.109           |                 |
| Academic subtotal                 |                | 0.299                             | 0.354  | 0.426  | 0.888  | 0.818  | 1.163  | 1.517  | 1.934  | 2.372  | 2.861  | 5.735  | 6.362                | 7.427           | 13.586          | 20.409          |                 |
| Total (current LCU)               |                | 4.459                             | 5.096  | 5.863  | 11.827 | 11.732 | 13.681 | 16.401 | 20.103 | 23.638 | 28.706 | 57.946 | 66.052               | 80.495          | 137.429         | 225.829         |                 |
| GDP deflator (1985=100)           |                | 14.2                              | 17.8   | 22.4   | 27.0   | 33.2   | 41.7   | 55.6   | 72.1   | 100.0  | 136.9  | 175.4  | 281.6                | 403.0           | 666.3           | 1188.0          | 2249.4          |
| Total (constant 1985 LCU)         |                | 31.444                            | 28.707 | 26.227 | 43.753 | 35.341 | 32.846 | 29.497 | 27.902 | 23.638 | 20.969 | 33.043 | 23.459               | 19.680          | 20.625          | 19.009          |                 |
| Total (constant 1985 PPP dollars) |                | 35.503                            | 32.413 | 29.617 | 49.402 | 39.903 | 37.087 | 33.305 | 31.504 | 26.690 | 23.676 | 37.308 | 26.487               | 22.221          | 23.288          | 21.463          |                 |
| Sources:                          |                | 1474                              | 1474   | 1474   | 1474   | 1474   | 1474   | 1474   | 1474   | 1474   | 1474   | 1474   | 1310; 445; 1474      | 1310; 445; 1474 | 1310; 445; 1474 | 1310; 445; 1474 | 1310; 445; 1474 |

Note: Expenditure data were only available for ARC. For the other institutes the ARC's expenditures per researcher has been used to calculate total expenditures.

### Appendix 6: Research staff development by institute, 1961-91

| Institute: Agricultural Research Cooperation (ARC) |  | 1961 | 1962  | 1963 | 1964 | 1965 | 1966 | 1967 | 1968  | 1969 | 1970 | 1971 | 1972  | 1973  | 1974  | 1975  | 1976  |
|--|--|------|-------|------|------|------|------|------|-------|------|------|------|-------|-------|-------|-------|-------|
| Nationals  |  |      |       |      |      |      |      |      |       |      |      |      |       |       |       |       |       |
| PhD  |  |      |       |      |      |      |      |      |       |      |      |      |       |       |       |       |       |
| MSC  |  |      |       |      |      |      |      |      |       |      |      |      |       |       |       |       |       |
| BSc  |  |      |       |      |      |      |      |      |       |      |      |      |       |       |       |       |       |
| Subtotal   |  | 26.0 | 29.1  | 32.1 | 35.2 | 38.4 | 41.6 | 44.8 | 56.2  | 67.6 | 79   | 91.4 | 103.9 | 116.3 | 128.7 | 141.1 | 153.6 |
| Expatriates  |  | 15.8 | 14.3  | 12.9 | 11.5 | 10.1 | 8.7  | 7.2  | 5.8   | 4.4  | 3    | 2.6  | 2.1   | 1.7   | 1.3   | 0.9   | 0.4   |
| Total  |  | 41.8 | 43.4  | 45   | 46.8 | 48.5 | 50.2 | 52   | 62.0  | 72.0 | 82   | 94.0 | 106.0 | 118.0 | 130.0 | 142.0 | 154.0 |
| Sources:   |  |      |       | 852  |      |      |      | 10   |       |      | 175  |      |       |       |       |       |       |
| Nationals  |  | 1977 | 1978  | 1979 | 1980 | 1981 | 1982 | 1983 | 1984  | 1985 | 1986 | 1987 | 1988  | 1989  | 1990  | 1991  | 1992  |
| PhD  |  |      |       |      |      |      |      |      |       |      |      |      |       |       |       |       |       |
| MSC  |  |      |       |      |      |      |      |      |       |      |      |      |       |       |       |       |       |
| BSc  |  |      |       |      |      |      |      |      |       |      |      |      |       |       |       |       |       |
| Subtotal   |  | 54   | 46.0  | 38   | 40.6 | 54   | 50   | 29   | 23.0  | 17   | 17   | 17   | 17    | 37    | 37    | 37    |       |
| Expatriates  |  | 166  | 163.5 | 161  | 164  | 218  | 200  | 202  | 202.0 | 202  | 202  | 202  | 202   | 218   | 218   | 218   |       |
| Total  |  | 166  | 163.5 | 161  | 164  | 218  | 200  | 202  | 202.0 | 202  | 202  | 202  | 202   | 218   | 218   | 218   |       |
| Sources:   |  | 252  |       | 251  | 73   | 251  | 250  | 76   |       | 999  | 999  | 999  | 999   | 999   | 999   | 999   |       |

Note: in 1958 ARC employed 17 national scientists and 20 expatriates (source 0287).

| Animal Production Research Administration (APRA) |  | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
|--|--|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Nationals  |  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| PhD  |  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| MSC  |  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| BSc  |  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Subtotal   |  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Expatriates                                      |  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Total  |  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Sources:   |  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Nationals  |  | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
| PhD  |  | 3    | 3.8  | 4.5  | 5.2  | 6.0  | 6.8  | 7.5  | 8.2  | 9    | 9    | 9    | 6    | 6    | 6    | 6    |      |
| MSC  |  | 8    | 9.2  | 10.5 | 11.8 | 13.0 | 14.2 | 15.5 | 16.8 | 18   | 18   | 18   | 23   | 23   | 23   | 23   |      |
| BSc  |  | 18   | 15.8 | 13.5 | 11.2 | 9.0  | 6.8  | 4.5  | 2.2  | 0    | 0    | 0    | 2    | 2    | 2    | 2    |      |
| Subtotal   |  | 29   | 28.8 | 28.5 | 28.2 | 28.0 | 27.8 | 27.5 | 27.2 | 27   | 27   | 27   | 31   | 31   | 31   | 31   |      |
| Expatriates                                      |  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Total  |  | 29   | 28.8 | 28.5 | 28.2 | 28.0 | 27.8 | 27.5 | 27.2 | 27   | 27   | 27   | 31   | 31   | 31   | 31   |      |
| Sources:   |  | 252  |      | 251  | 73   | 251  | 250  | 76   |      | 999  | 999  | 999  | 999  | 999  | 999  | 999  |      |

**Appendix 6: Research staff development by institute, 1961-91 (contd.)**

|   | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Institute: Veterinary Research Laboratories Administration (VRLA) |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Nationals   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| PhD   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| MSC   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| BSc   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Subtotal  |      |      |      |      |      |      |      |      |      | 17   | 19.6 | 22.1 | 24.7 | 27.3 | 29.9 | 32.4 |
| Expatriates   |      |      |      |      |      |      |      |      |      | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Total   |      |      |      |      |      |      |      |      |      | 17   | 19.6 | 22.1 | 24.7 | 27.3 | 29.9 | 32.4 |
| Sources:  |      |      |      |      |      |      |      |      |      | 532  |      |      |      |      |      |      |
| Institute: Veterinary Research Laboratories Administration (VRLA) |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Nationals   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| PhD   |      |      |      |      |      |      |      |      |      |      | 27   | 27   | 27   | 27   | 54   |      |
| MSC   |      |      |      |      |      |      |      |      |      |      | 39   | 39   | 39   | 39   | 63   |      |
| BSc   |      |      |      |      |      |      |      |      |      |      | 20   | 20   | 20   | 20   | 20   |      |
| Subtotal  | 35   | 40.1 | 45.2 | 50.3 | 55.4 | 60.5 | 65.6 | 70.7 | 75.8 | 80.9 | 86   | 86   | 86   | 86   | 137  |      |
| Expatriates   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Total   | 35   | 40.1 | 45.2 | 50.3 | 55.4 | 60.5 | 65.6 | 70.7 | 75.8 | 80.9 | 86   | 86   | 86   | 86   | 137  |      |
| Sources:  | 252  |      |      |      |      |      |      |      |      |      | 999  | 999  | 999  | 999  | 999  |      |

|  | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
|--|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Faculty of Agriculture, University of Khartoum (FA-UK) |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Nationals  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| PhD  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| MSC  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| BSc  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Subtotal   | 14.0 | 17.2 | 20.4 | 23.7 | 26.9 | 30.1 | 33.3 | 36.6 | 39.8 | 43.0 | 41.3 | 39.7 | 38.0 | 42.4 | 46.9 | 51.3 |
| Expatriates  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  |
| Total  | 15   | 18.2 | 21.4 | 24.7 | 27.9 | 31.1 | 34.3 | 37.6 | 40.8 | 44   | 42.3 | 40.7 | 39   | 43.4 | 47.9 | 52.3 |
| FTE research   | 0.8  | 0.9  | 1.1  | 1.2  | 1.4  | 1.6  | 1.7  | 1.9  | 2.0  | 2.2  | 2.1  | 2.0  | 2.0  | 2.2  | 2.4  | 2.6  |
| Sources:   | 888  |      |      |      |      |      |      |      |      | 532  |      |      | 888  |      |      |      |
| Faculty of Agriculture, University of Khartoum (FA-UK) |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Nationals  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| PhD  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| MSC  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| BSc  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Subtotal   | 55.8 | 60.2 | 64.7 | 69.1 | 73.6 | 78   | 79.7 | 81.3 | 83   | 83   | 83   | 83   | 81   | 81   | 81   | 81   |
| Expatriates  | 1.0  | 1.0  | 1.0  | 1.0  | 1.0  | 1    | 1.0  | 1.0  | 1    | 1    | 1    | 1    | 0    | 0    | 0    | 0    |
| Total  | 56.8 | 61.2 | 65.7 | 70.1 | 74.6 | 79   | 80.7 | 82.3 | 84   | 84   | 84   | 84   | 81   | 81   | 81   | 81   |
| FTE research   | 2.8  | 3.1  | 3.3  | 3.5  | 3.7  | 4.0  | 4.0  | 4.1  | 4.2  | 4.2  | 4.2  | 4.2  | 4.0  | 4.0  | 4.0  | 4.0  |
| Sources:   |      |      |      |      |      | 979  |      |      | 999  | 999  | 999  | 999  | 999  | 999  | 999  | 999  |

Note: Faculty time spent on research has been estimated at 5%.

**Appendix 6: Research staff development by institute, 1961-91 (contd.)**

|   | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Faculty of Veterinary Medicine, University of Khartoum (FVM-UK) |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Nationals   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| PhD   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| MSc   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| BSc   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Subtotal  |      |      |      |      |      |      |      |      |      | 27   | 31.7 | 36.3 | 41.0 | 41.9 | 42.8 | 43.7 |
| Expatriates   |      |      |      |      |      |      |      |      |      | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Total   | 18.0 | 19.0 | 20.0 | 21.0 | 22.0 | 23.0 | 24.0 | 25.0 | 26.0 | 27   | 31.7 | 36.3 | 41   | 41.9 | 42.8 | 43.7 |
| FTE research  | 5.4  | 5.7  | 6.0  | 6.3  | 6.6  | 6.9  | 7.2  | 7.5  | 7.8  | 8.1  | 9.5  | 10.9 | 12.3 | 12.6 | 12.8 | 13.1 |
| Sources:  |      |      |      |      |      |      |      |      |      | 532  |      |      | 888  |      |      |      |
|   | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
| Nationals   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| PhD   |      |      |      |      |      | 42   | 45.0 | 48.0 | 51   | 51   | 51   | 42   | 42   | 40   | 40   |      |
| MSc   |      |      |      |      |      | 0    | 0    | 0    | 0    | 0    | 0    | 1    | 1    | 15   | 15   |      |
| BSc   |      |      |      |      |      | 7    | 4.7  | 2.3  | 0    | 0    | 0    | 5    | 5    | 0    | 0    |      |
| Subtotal  | 44.6 | 45.4 | 46.3 | 47.2 | 48.1 | 49   | 49.7 | 50.3 | 51   | 51   | 51   | 48   | 48   | 55   | 55   |      |
| Expatriates   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Total   | 44.6 | 45.4 | 46.3 | 47.2 | 48.1 | 49   | 49.7 | 50.3 | 51   | 51   | 51   | 48   | 48   | 55   | 55   |      |
| FTE research  | 13.4 | 13.6 | 13.9 | 14.2 | 14.4 | 14.7 | 14.9 | 15.1 | 15.3 | 15.3 | 15.3 | 14.4 | 14.4 | 16.5 | 16.5 |      |
| Sources:  |      |      |      |      |      | 979  |      |      | 999  | 999  | 999  | 999  | 999  | 999  | 999  |      |

Note: Faculty time spent on research has been estimated at 30%.

|   | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Institute of Animal Production, University of Khartoum (IAP-UK) |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Nationals   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| PhD   |      |      |      |      |      | 4.2  | 8.5  | 12.8 | 17   | 17   | 17   | 17   | 15   | 15   | 15   |      |
| MSc   |      |      |      |      |      | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| BSc   |      |      |      |      |      | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Subtotal  |      |      |      |      |      | 4.2  | 8.5  | 12.8 | 17   | 17   | 17   | 17   | 15   | 15   | 15   |      |
| Expatriates   |      |      |      |      |      | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Total   | —    | —    | —    | —    | —    | 4.2  | 8.5  | 12.8 | 17   | 17   | 17   | 17   | 15   | 15   | 15   |      |
| FTE research  | —    | —    | —    | —    | —    | 1.3  | 2.6  | 3.8  | 5.1  | 5.1  | 5.1  | 5.1  | 4.5  | 4.5  | 4.5  |      |
| Sources:  |      |      |      |      |      |      |      |      | 999  | 999  | 999  | 999  | 999  | 999  | 999  |      |

Note: Faculty time spent on research has been estimated at 30%.

### Appendix 6: Research staff development by institute, 1961-91 (contd.)

| Institute of Environmental Studies, University of Khartoum (IES-UK) |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|   | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
| Nationals   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| PhD   |      |      | 0.2  | 0.5  | 0.7  | 1.0  | 1.2  | 1.5  | 2    | 2    | 2    | 2    | 2    | 2    | 2    |      |
| MSC   |      |      | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| BSc   |      |      | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Subtotal  |      |      | 0.2  | 0.5  | 0.7  | 1.0  | 1.2  | 1.5  | 2    | 2    | 2    | 2    | 2    | 2    | 2    |      |
| Expatriates   |      |      | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Total   |      |      | 0.2  | 0.5  | 0.7  | 1.0  | 1.2  | 1.5  | 2    | 2    | 2    | 2    | 2    | 2    | 2    |      |
| FTE research  |      |      | 0.2  | 0.4  | 0.7  | 0.9  | 1.1  | 1.3  | 1.8  | 1.8  | 1.8  | 1.8  | 1.8  | 1.8  | 1.8  |      |
| Sources:  |      |      |      |      |      |      |      |      | 999  | 999  | 999  | 999  | 999  | 999  | 999  |      |

Note: Faculty time spent on research has been estimated at 90%.

| Faculty of Natural Resources, University of Juba (FNR-UJ) |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|   | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
| Nationals   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| PhD   |      |      |      |      |      | 20   | 20.3 | 20.7 | 21   | 21   | 21   | 21   | 24   | 24   | 25   |      |
| MSC   |      |      |      |      |      | 10   | 8.3  | 6.7  | 5    | 5    | 5    | 5    | 10   | 10   | 11   |      |
| BSc   |      |      |      |      |      | 10   | 6.7  | 3.3  | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Subtotal  |      |      |      |      |      | 40   | 35.3 | 30.7 | 26   | 26   | 26   | 26   | 34   | 34   | 36   |      |
| Expatriates   |      |      |      |      |      | 2    | 2.0  | 2.0  | 2    | 2    | 2    | 2    | 4    | 4    | 2    |      |
| Total   |      |      |      |      |      | 42   | 37.3 | 32.7 | 28   | 28   | 28   | 28   | 38   | 38   | 38   |      |
| FTE research  |      |      |      |      |      | 2.1  | 1.9  | 1.6  | 1.4  | 1.4  | 1.4  | 1.4  | 1.9  | 1.9  | 1.9  |      |
| Sources:  |      |      |      |      |      | 979  |      |      | 999  | 999  | 999  | 999  | 999  | 999  | 999  |      |

Note: Faculty time spent on research has been estimated at 5%.

| Faculty of Agriculture, University of Gezira (FA-UG) |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|--|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|  | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
| Nationals  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| PhD  |      |      |      |      |      |      | 24   | 25.5 | 27.0 | 28.5 | 30.0 | 31.5 | 33   | 36   | 40   | 42   |
| MSC  |      |      |      |      |      |      | 0    | 0.7  | 1.3  | 2.0  | 2.7  | 3.3  | 4    | 4    | 8    | 10   |
| BSc  |      |      |      |      |      |      | 4    | 3.3  | 2.7  | 2.0  | 1.3  | 0.7  | 0    | 0    | 0    | 0    |
| Subtotal   |      |      |      |      |      |      | 28   | 29.5 | 31.0 | 32.5 | 34.0 | 35.5 | 37   | 40   | 48   | 52   |
| Expatriates  |      |      |      |      |      |      | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Total  |      |      |      |      |      |      | 28   | 29.5 | 31.0 | 32.5 | 34.0 | 35.5 | 37   | 40   | 48   | 52   |
| FTE research   |      |      |      |      |      |      | 5.6  | 5.9  | 6.2  | 6.5  | 6.8  | 7.1  | 7.4  | 8.0  | 9.6  | 10.4 |
| Sources:   |      |      |      |      |      |      | 979  |      |      |      |      |      | 999  | 999  | 999  | 999  |

Note: Faculty time spent on research has been estimated at 20%.



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