Report on ATMS in the Sudan

THE AGRICULTURAL TECHNOLOGY MANAGEMENT SYSTEM IN THE SUDAN

Part 1. Report on the Seminar on ATMS in the Sudan
AOAD Headquarters, Khartoum, Sudan
August 2-3, 1988

Part 2. Report to the Minister of Agriculture and Natural Resources on the ATMS in the Sudan

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Part 1

Report on the Seminar on

AGRICULTURAL TECHNOLOGY MANAGEMENT SYSTEM IN THE SUDAN

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Agricultural Technology Management System in the Sudan

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MANR/AOAD/ISNAR SEMINAR
on
The Agricultural Technology Management System in the Sudan

AOAD Headquarters, Khartoum, Sudan,
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AGENDA

Tuesday, August 2

09:30 - 10:30		OPENING SESSION: - Address by Dr. Hassan Fahmi Jumah, Director General, AOAD - Address by Dr. Howard Elliott, Deputy Director General for Research and Training, ISNAR - Address by H.E. Dr. El Fatih El Tigani, Minister of Agriculture and Natural Resources
10:30 - 11:00		COFFEE
11:00 - 13:30		FIRST SESSION: PRESENTATION OF THE STUDY (Chairperson: Prof. Saad Abbadi)
	11:00-11:15	Purpose and Objectives of the Study (Dr. Mohamed O. Mohamed Salih, Deputy Director General, AOAD)
	11:15-11:45	ATMS Methodology (Dr. Howard Elliott, Deputy Director General, ISNAR)
	11:45-12:00	Formation of Local Study Team and Collection of Data (Dr. A. Hamdoun, Team Leader)
	12:00-13:30	Data Analysis, Draft Report Writing and Functional Analysis (Dr. Ghazi Hariri, Senior Research Officer, ISNAR)
14:00 - 15:30		LUNCH Courtesy of H.E. the Minister of Agriculture and Natural Resources

Wednesday, August 3

09:30 - 11:30		SECOND SESSION: PRESENTATION OF THE STUDY (Chairperson: Dr. Adam M. Shomein, Ministry of Animal Resources)
	09:30-10:30	Institutional Analysis (Dr. A. Hamdoun, Team Leader)
	10:30-11:30	Human Resources Analysis (Dr. A. El Sheikh, Team Member)
11:30 - 12:00		COFFEE
12:00 - 14:00		THIRD SESSION: PLENARY DISCUSSION OF PRESENTATIONS, SUMMARY AND RECOMMENDATIONS (Chairperson: Dr. Kamil Mansour, Advisor to the Minister of Agriculture and Natural Resources)
14:30 - 16:00		LUNCH Courtesy of the Director General of AOAD

REPORT OF THE SEMINAR

Introduction

Objective of the Workshop

The workshop was formally part of the methodology for reviewing Agricultural Technology Management Systems. It provided a forum in which the objectives of the review, the approaches followed, and the issues raised could be openly discussed by those with an interest in the outcome of detailed analysis of the Agricultural Technology Management System of the Sudan.

The study took a systems and contingency approach. Identifying key functions that an agricultural technology management system had to perform, it looked for improvements of a structural and operational nature that would increase the effectiveness of the system. It provided certain analytical tools which were tested by a national study team. The methodology was very clear, both in the presentation of the data and the analysis made on the basis of the data collected.

In the discussion of methodology, attention could be focused on the systems framework used, the particular tools of analysis applied, the accuracy of the information collected, and the compatibility of the recommendations with the study methodology and the realities of the Sudan.

Since the analysis led to discussion of additional agricultural technology management issues not focused on by the review, the workshop provided both a forum and a framework within which they could be discussed.

Workshop Procedures

The meeting opened with introductory addresses by Dr. Hassan Fahmi Jumah, Director General, AOAD; H.E. El Fatih El Tigani, Minister of Agriculture and Natural Resources; and Dr. Howard Elliott, Deputy Director General for Research and Training, ISNAR. These addresses are reproduced as Annex I to the present report of the workshop.

There then followed a series of presentations of different aspects of the study and plenary discussion. The sessions were as follows:

a) Objectives of the Study
b) ATMS Methodology
c) Formation of Team and Data Collection Procedures
d) Data Analysis, Report Writing, and Functional Analysis
e) Institutional Analysis
f) Human Resources Analysis
g) Plenary Discussion of Presentations, Summary, and Recommendations

I. Objectives of the Study

The objectives of the study were described as follows:

a) to examine the Agricultural Technology Management System of the Sudan;

b) to identify ways of strengthening agricultural research policy, organization, and management;
c) to focus on key management issues affecting the productivity of research; and
d) to make recommendations for improvements in either structures or mechanisms in order to increase the productivity of the ATMS.

There was agreement on the appropriateness of the objectives of the study. As noted below, the methodology provides a framework for discussion of <u>alternative</u> ways to improve the structure and mechanisms of the system. It was underlined that procedural improvements may be alternatives to structural changes as ways of improving the performance of key ATMS functions.

II. Discussion of the ATMS methodology

There was general agreement on the main characteristics of the ATMS approach. These were:

1) a systems and contingency approach which aims at structures and procedures appropriate to the Sudanese political structure, development policy, and administrative system;

2) a fully clear analysis which lays out the analysis of research policy, organization and management on which recommendations are based;

3) the identification of key functions which must be performed and the discussion of what structures and mechanisms are most appropriate for performing them;

4) the possibility of using the methodology to examine the feasibility and desirability of alternative ways of carrying out the key functions.

There was a strong endorsement of an approach which went beyond a narrow look at the research system and considered the broader technologgy management system.

In the application of the methodology there was some concern:

1) that the arguments leading from the diagnosis to the recommendations were not sufficiently developed (This was most often discussed with respect to the recommendation for creating a Sudan Agricultural Research Council.);
2) that the methodology, which calls for the examination of possible improvements did not present clear alternatives such as strengthening the existing Agricultural Research Council or giving the coordination function to the largest organization, the Agricultural Research Corporation; and
3) that the institutional analysis concentrated largely on human resource issues, and it did not go deeply enough into internal functioning and the adequacy of other resources.

III. Discussion of Report Preparation and Drafting

There was very little discussion of the actual processes for report preparation and drafting, although the following points were noted:

1) There are some inconsistencies in reporting information in The Background of Sudan's Agriculture, Chapter II, which is in effect an executive summary of information found in Chapter III, the main body of information; e.g., there is some inconsistency in reporting figures in both places (for population growth, crop yields, etc.) It was agreed that these did not affect the conclusions of the report but should be corrected. (They have been duly corrected in the accompanying report.)

2) The report generated considerable valuable information about the economy as a whole and the agricultural sector in particular. Some of the statistics can be verified against different figures from other sources.

3) There was incomplete reporting of some institutions, with the result that statements about staffing patterns and degree achievements can not be made with statistical confidence for those institutions, particularly in the livestock sector. APRA, for example, has 44 scientists, and only 5 were surveyed. Thus, APRA management has subsequently provided a detailed human resource inventory, which has been added to the report.

IV. Discussion of the Functional Analysis

Several points were raised about the functional analysis.
First, where participants traced the contribution of particular organizations to the 13 ATMS functions, they agreed that the study team had correctly identified the situation. However, additional information on the mechanism for participation in those functions was required. This would be required if readers were to judge whether improvement of the mechanism was an alternative to structural change.

Second, there were certain organizations whose role was inadequately represented. The Ministry of Finance and Economic Planning has a determining role in all economic decisions affecting agricultural research. This led one participant to suggest that its planning committees might have a coordinating role in agricultural research.

Third, as stated in the introductory paper on methodology, the information in a functional analysis can be used to generate a range of alternative improvements. This range of alternatives should have been presented prior to recommendations.

V. Discussion of the Institutional Analysis

The Institutional Analysis was based on information provided by eight key organizations involved in agricultural research. The information included their legal status, mandate, principal clients, functions, and linkages to other organizations in the ATMS. There was no comment or criticism of Table 1, which presents the institutional profiles.

An analysis of the research sector based on human resource indicators calculated from information in the institutional questionnaires followed. It painted a picture of the sector, in which ARC was the largest single institution, but the two livestock research organizations and FAUK combined are more than 75% the size of ARC. In short, one cannot consider the agricultural research sector to be only ARC, especially when the two university faculties (Gezira and Khartoum) are 2/5 the size of ARC.

Scientist qualifications, experience, and support staff ratios were used to build up a picture of a system with generally adequate numbers of scientists, high levels of qualification and experience, but subject also to high levels of turnover. There were also indications that certain discipline imbalances existed.

In comment, participants brought out the following qualifications and criticisms:

1) The aggregate picture of the "agricultural research sector" in the Sudan, composed of some 875 scientists, is an exaggerated one, since staff in faculties do not do full-time research. Consequently, the real full-time equivalent number of agricultural researchers is much lower than 875.

2) The conclusion of disciplinary imbalance within institutions, and within the sector as a whole, needs to be drawn with respect to priorities and programs. It was generally accepted, however, that there was some over-representation in traditional disciplines (such as agronomy, breeding, entomology), while there was under-representation in non-traditional disciplines. Moreover, the figures demonstrated that this distortion was not likely to be changed by trainees currently in the pipeline; it would have to be addressed by a new training strategy.

3) The low technician to scientist ratio mentioned for the universities could be interpreted not as a low support ratio but as confirmation of the opinion that the universities' research is carried out mostly by postgraduate students, where technicians are not as needed as in research institutions.

4) One participant would have liked the institutional analysis to report on a wider range of physical resources (buildings, equipment, vehicles, machinery); financial inputs to wages versus operating costs; and the internal management problems of particular institutions. This reflected the view of some participants that there are problems which are not system-level problems but which must be addressed at the level of management of individual institutions and programs.

5) Finally, it was noted that numerous seminars have discussed the lack of coordination between research and extension. It is recognized that several models are operating within the country, but no effective solution has yet been found.

VI. Discussion of Human Resources

The chapter on human resources was very closely linked to the chapter reporting the Institutional Profiles, and as a matter of procedure, the two were discussed together at the workshop.

It was noted that there was some undercounting in certain institutions, and there was no information at all from Juba Univeristy. However, the aggregate picture of human resources could be described reasonably accurately with respect to the current situation, training needs, and conditions of service. The following points were highlighted by the speakers:

1) With 875 researchers in the potential "pool", Sudan has an adequate number of scientists.

2) The high ratio of Ph.D. scientists to total scientists places it among the best-staffed systems in the region and in Africa, leading to some concern about the imbalance between highly qualified and technical support staff.

3) When staff were surveyed about their training needs, most cited types of formal training leading to degrees and promotion rather than task-oriented training.

4) Conditions of service for agricultural researchers, after standardization for housing and other allowances, appeared to be significantly below those in the universities. This comparison led the team to wonder about the incentives for researchers to serve in difficult environments.

5) Although the experience levels (years of service) are relatively high by African standards (48% > 11 years), there was concern about problems of retention. The system is an old one, and the statistics on those remaining in the system do not take account of the even more experienced scientists who have taken jobs outside the sector or outside Sudan.

6) In recent years (1980-87) there has been low net growth in staffing compared to the period 1975-80.

In discussion, comments on the human resource chapter dealt with the completeness of the information presented and the accuracy of inferences drawn from it. In particular, the following concerns were expressed:

1) APRA has 44 scientists, of which only five are surveyed. The Veterinary Research Administration has 127 scientists, of which only one was recorded. This did not, however, affect the coverage of APRA in the Institution Profile chapter. Information on the 44 scientists, provided during the symposium, has been included in Part II.

2) The under-analysis of the concerns of the livestock sector were considered by its spokesmen to be representative of the way it has been traditionally ignored in policy discussions.

3) The technicians reported for the livestock institutes, although numerically large, were considered not to be of adequate quality.

4) The analysis needs to be complemented by a regional perspective in the country. Data are reported by commodity rather than region, masking the fact that there is an over-concentration of resources in Wad Medani and Khartoum. It was pointed out, for example, that out of 26 research professors at ARC, 20 were in Wad Medani and 2 in Khartoum. The experience levels of researchers in remote environments was less than of those in Khartoum and Wad Medani.

General Plenary Discussion on All ATMS Issues

The chairman of the session called for brief comments on the general findings of the study and other issues which came up in either the opening addresses or in the course of discussion.

In his charge to the seminar, the Minister had stressed the importance of agricultural research but noted several problems:

1) the limited impact on the farmer, particularly in the rainfed sector;

2) the lack of attention to livestock relative to cropping;

3) the weakness of linkages among organizations working in the sector, particularly between the universities and the research institutions; and

4) the lack of a research strategy from which a long-term research program could be drawn up.

Explicitly, the Minister wished to know if the research organization and the research processes were the correct ones for a coherent research strategy reflecting agricultural development goals.

The Plenary Discussion focused on the following main issues:

1) the need for a coherent development and research strategy;

2) the need for greater attention to "neglected" areas (livestock, forestry, wildlife);

3) the need for better coordination of agricultural research (including livestock, forestry, fisheries) and food technology;

4) the recommendation of the draft report for the creation of a Sudan Agricultural Research Council; and

5) the lack of ability of the research sector to influence policies that impinge on its success.

Various speakers intervened on both sides of the strategy issue. The lack of a clear research strategy and the lack of adequate attention to certain "neglected" areas was variously attributed to the lack of a clear development strategy from which a research strategy could be derived;

organizational weaknesses which prevented a coherent plan for the sector; and internal imbalances within particular organizations. Particular mention was made of the difficulty of integrating the four centers -- Food, Forestry, Wildlife, and Fisheries -- into ARC's structure. They see themselves as marginalized, both administratively and strategically. Common to all points of view, however, was an expression of inadequate training and operating funds.

The need for better coordination of agricultural research could not be dissociated in the discussions from the particular recommendation of the draft study for the creation of a Sudan Agricultural Research Council. This recommendation brought forth great discussion, both in terms of its implications and its relationship to the use of the methodology itself.

The methodology, particularly the functional analysis, was accepted as being useful in identifying the key functions which must be carried out, in describing the present structures and mechanisms that are in place to perform these functions, and in helping to generate a range of explicit alternatives for improving the performance of the function. Several speakers called for consideration of explicit alternatives to the creation of a SARC. In particular, more detail on the possibility of improving existing structures and existing mechanisms for coordination was needed before recommending a structural solution in the creation of a new body. There was general agreement, however, that the existing Agricultural Research Council of the National Council for Research had not functioned as an effective coordinating body. This was variously attributed to the lack of distributive power of NCR itself, the lack of financial resources allocated to NCR, and its interests, which extend beyond the agricultural sector.

With respect to the influence of the research sector on policies impinging on its success, there was general agreement that researchers had not contributed adequately in institutional ways to the policy dialogue. The ability of donor projects to further fragment the policy and organization of research was highlighted. It was suggested that case studies of donor projects would have given insights into the functioning of the system. The consensus was that research follows the source of financing. The participants saw a clear development strategy and a clear research strategy as prerequisites for a sound policy dialogue.

With respect to coordination of agricultural research, and the alternatives for improving it, the functional analysis can be complemented by further detail, which amounts to a "client and stakeholder analysis". Explicit criteria for evaluating alternatives may be suggested.

The Minister in his address argued for coordination, improved linkages, and new priorities to livestock and the rainfed sector in the interest of the system's only clients, the farmers.

Introduction of new priorities requires the active participation of the institutions which have a stake in the outcome of the proposed changes (the system's "stakeholders"). As part of a strategic planning process, coordination will come about through a body which has many of the following characteristics:

1) It is close to the system's client and knows their technical needs.

2) It will represent agricultural research effectively in two forums:
   a) the allocation for agricultural research priorities in competition with other forms of expenditures on agriculture; and
   b) the allocation for agricultural research priorities in competition with other forms of scientific and technical research.

3) It will be recognized by otherwise competing institutions as the form in which their activities are rationalized.

4) It is compatible with existing political structures and mechanisms for decision making within the country.

5) It can adequately represent the national, regional, and local needs for research.

In plenary discussion, various alternatives for improving the coordination of agricultural research and arriving at a coherent strategy for the sector were mentioned. These included:

1) creation of a Sudan Agricultural Research Council under the Ministry of Agriculture;

2) coordination through the largest individual institute, the Agricultural Research Corporation;

3) creation of an Interministerial Council, in which representatives of MANR, MAR, and the universities are represented;

4) coordination through the Planning Committee for the Agricultural Sector of the Ministry of Finance and Economic Planning;

5) strengthening the resources and role of the Agricultural Research Council of the National Council for Research.

The above were mentioned in the course of discussion but are not the only alternatives possible. Time did not permit an analysis of all the alternatives, and a hasty consideration was deemed unproductive. There was agreement, however, that alternatives to a "SARC" needed to be carefully considered. The key issue seems to be whether Sudan requires strengthening of scientific policy in general or agricultural research policy in a problem-solving perspective.

Finally, it was underlined that the problems facing agricultural research are not all found at the policy and system levels. There are issues of internal planning, organization, and management which also need to be resolved and can lead to improvement of research impact, even in the absence of system-level improvement. This includes improved procedures for programming and budgeting which allocate resources to programs rather than administrative units.

Conclusion

The collaboration of a local study team with an international research center and a regional organization has produced a fruitful input into an ongoing dialogue on the ways to strengthen national agricultural research in the Sudan. The participation of a broad range of informed and interested parties brought new insights to the discussion as part of a process which was welcome to those present. A basis was laid for decisions that can only be taken by competent national authorities following a consensus-building process.

Opening Address by His Excellency Dr. E. Fatih El Tigani, Minister of Agriculture and Natural Resources, Republic of the Sudan

الأخ الدكتور/ حسن فهمى جمعه ،

المدير العام للمنظمة العربية للتنمية الزراعية

الدكتور/ هوارد إليوت ، نائب المدير العام لإسنار

الأخ الدكتور/ غازى الحريرى

الاخوة العلماء الأجلاء

السادة الحاضرون

يطيب لى أن ألتقى بجمعكم الكريم اليوم وأنتم تبدأون مداولاتكم ومناقشاتكم حول الدراسة التى تم اعدادها حول نظم البحوث الزراعية فى السودان والتى نأمل أن تتولد عنها توصيات ومقترحات محددة يمكن من خلالها اصلاح وتقويم الوضع العام للبحوث الزراعية فى البلاد .

أيها الاخوة ،

اسمحوالى فى هذه العجالة أن استعرض معكم وفى إيجاز بعض الملامح عن أوضاع البحوث الزراعية فى البلاد والتى أرى أن لها بعض الانعكاسات السلبية على مجمل مسار التنمية الزراعية ، وذلك على أمل أن تكون من ضمن نقاط النقاش والحوار فى ندوتكم هذه :-

أولا : ان الجانب الأكبر من برامج البحوث الزراعية موجه لمحاصيل محدودة فى القطاع الزراعى المروى ومع تقديرنا للتوجهات التى حدثت مؤخرا لدفع العمل البحثى الزراعى فى القطاع المطرى إلا أن هذه التوجهات مازالت متواضعة ولا تتفق مع حجم المشكلات التى تواجه هذا القطاع الهام .

ومن جهة أخرى فإن كثيراً من نتائج البحوث التى توصلنا إليها لم تتعد محطات البحوث ولم نتمكن من ايصالها للمزارع بسبب ضعف الصلة

العضوية بين أجهزة البحوث الزراعية واجهزة الارشاد الزراعى والنتيجة أن مستويات الانتاجية على مستوى الحقول والمزارع لكثير من محاصيلنا مازالت متدنية بالمقارنة بالمتوسطات العالمية .

ثانيا : أن مجالات البحث العلمى فى الانتاج الحيوانى مازالت محدودة ومازال أمامنا أشواط بعيدة لتطوير الصفات الوراثية للقطعان المحلية بهدف زيادة أنتاجيتها من اللحوم والألبان والمنتجات الحيوانية الأخرى .

ثالثا : أن هناك تشتتا كبيرا فى المجهودات البحثية الجارية حاليا فى البلاد بما لايتفق مع ندرة الموارد المتاحة من جهة وتعدد وحدة المشكلات التى تواجه القطاع الزراعى من جهة أخرى ، وأشير هنا على وجه التحديد عدم تمكننا حتى الآن من ربط العمل البحثى فى الجامعات والمعاهد بالعمل البحثى فى المؤسسات والوحدات خارج الاطار الجامعى ومن ثم عدم تمكننا من الاستفادة الكاملة من الامكانيات الكبيرة المتاحة فى مؤسسات التعليم العالى لحل مشكلات الانتاج الزراعى .

رابعا : إننا ورغم قدم عهدنا بالبحوث الزراعية ،فما زلنا نفتقد وجود استراتيجية وسياسة عامة للبحوث الزراعية توضح الملامح الأساسية لبرامج البحث العلمى الزراعى على المدى الطويل وتنبثق منها برامج المدى القصير على أساس أولويات وأهداف تنمية القطاع الزراعى .

أيها الأخوة ،

لقد أدت هذه الظواهر الأربعة إلى تعثر الأنشطة البحثية وعدم فعاليتها بالدرجة المطلوبة وأدت بالتالى إلى تعثر العمل التنموى الزراعى رغم الجهود التى بذلت من أجله .

وهذا الموقف يدعونا جميعا إلى التفكير الجاد والعمل المشترك للتغلب على الانعكاسات السلبية لهذه الظواهر والعمل على تجاوزها للحد الذى يمكننا من وضع البحوث الزراعية فى مسارها الصحيح حتى تتمكن من القيام بدورها الفعال فى دفع عجلة التنمية الزراعية فى البلاد .

وفى هذا الصدد اسمحوا لى بأن أشير إلى النقاط الأربعة التالية :-

أولاً : علينا أن نعيد النظر فى وضع البحوث الزراعية فى البلاد بحيث نتمكن من توجيهها وفق سياسة عامة ووفق برامج قائمة على أساس أولويات تتفق مع أهداف التنمية الزراعية فى البلاد من جهة ومع الموارد المتاحة من جهة أخرى .

ثانيا : علينا أن نعمل على زيادة الصلة والارتباط العضوى الفعال بين القائمين بالبحث العلمى وقادة الإرشاد الزراعى ليس فقط بهدف نقل نتائج البحوث الزراعية الى المزارعين وانما كذلك لنقل المشكلات العملية للتنفيذ على مستوى الحقل للقائمين بالبحوث .

ثالثاً : علينا أن نقيم نظاما لمتابعة نتائج تطبيق البحوث الزراعية على مستوى حقول المزارعين بهدف تقييم هذه النتائج وتحديد مدى تأثيرها على زيادة الانتاج وتحديد المشكلات التى تواجه التطبيق العملى لهذه النتائج .

رابعاً : علينا تقوية ودعم التعاون والعمل المشترك بين الجامعات ومعاهد البحث العلمى ومؤسسات البحث العلمى خارج الاطار الجامعى بحيث

تتم توجيه الموارد المتاحة فى هذه المؤسسات جميعها لخدمة أهـــداف التنمية الزراعيـة فى اطار من التكامل البنّاء .

أيـها الاُخـوة ،

أذا اتفقنا ان هذه الجوانب الاُربعة قد تساعدنا على التغلب عـــى السلبيات التى أشرت إليها فى مقدمة حديثى ، فالسؤال هو كيف يمكننا ضمان تنفيذها بحيث نتمكن من تجاوز السلبيات ؟

هل تتوفر لنا فى الاطر التنظيمية القائمة حاليا الآليـة ـ Mechanism اللازمة لوضع السياسات العامة للبحوث الزراعية ووضع الاُولويات وتأكيــــد الارتباط بين البحوث الزراعية والارشاد الزراعى والقيام بعملية المتابعـــة والتقييم لاُنشطة وبرامج البحوث الزراعية ودعم التعاون والعمل المشـــترك بين الجامعات ومراكز البحث العلمى الاُخـرى .

هل تتوفر لنا فى الوقت الحالى الآلية أو الاطار التنظيمى الذى في مقدوره أن يقوم بهذه المسؤوليات أم أننا في حاجة إلى اطار تنظيمى جديد خارج الاطـر التنظيمية القائمة حاليا للقيام بهذه المسؤوليات .

آمل من خلال مناقشاتكم ان تتمكنوا من وضع إجابة واضحة لهذا السؤال الهـام .

أيـها الاخــوة ،

إننا فى إطار جهودنا لدفع عجلة التنمية الزراعية فى البلاد مقتنعــون بأن البحوث الزراعية لا تستطيع أن تلعب دورها الكامل فى غياب المعطيات الاُساسية الاُخرى والخدمات المساعدة اللازمة لانجاح عملية التنمية الزراعيـة

وخاصة فى مجال توفير مدخلات الانتاج والتسليف الزراعى وتحسين المنشآت الأساسية فى مجال التسويق والتخزين وتحسين الطرق .

ومع ذلك ففى تقديرنا فإن المرتكز الأول لعملية التنمية الزراعية هى البحوث الزراعية التى يمكن أن تلعب دوراً أساسيا ومركزيا فى تطوير الانتاج الزراعى وتحديثه . وعلى ذلك فإن الجهود الأساسية يجب أن تنصب فى اتجاه دعمها ليس فقط فى مجال توفير الموارد البشرية والمالية بما يمكنها من تنفيذ برامجها البحثية ، ولكن بشكل أساسى فى مجال دعم البنية المؤسسية - Institutional set-up - لأجهزة البحوث الزراعية ووضع الاطر التنظيمية والأجهزة الادارية التى تمكن من وضع سياسة بحثية واضحة على المدى الطويل يمكن من خلافها توجيه مسار البحث العلمى الزراعى وفق احتياجات البلاد ووفق الموارد التاحة لها .

ونأمل ان تتضافر جهودنا جميعا خلال السنوات القادمة لدعم البحوث الزراعية وفق هذه الاتجاهات .

أيها الأخوة ،

فى الختام أود أن اتقدم بالشكر والتقدير لمنظمة اسنار - ISNAR - والعاملين بها لجهودهم القيمة فى مجال دعم البحوث الزراعية واشكرهم بالتحديد لاختيارهم للسودان كأول بلد عربى يتم فيه تطبيق النموذج الخاص بدراسة وضع نظم البحوث الزراعية فى الاقطار العربية وأود أن أوكد لهم جديتنا وسعينا الحثيث لمتابعة وتنفيذ ماتتوصل إليه هذه الندوة من توصيات .

كما أنني أتقدم بالشكر والامتنان للأخ الدكتور/حسن فهمي جمعـــة وزملائه الكرام بالمنظمة العربية للتنمية الزراعية على جهودهم المتواصلة لخدمـة أهداف التنمية الزراعية على امتداد وطننا العربي الكبير ونقدر لهم على وجـه الخصوص مساهماتهم في دفع عجلة التنمية الزراعية في السودان سواء كـان ذلك في مجال دراسات الجدوى أو في مجال التدريب أو في مجال العـون الفني ، وغير ذلك من المجالات التي أثرت ولاشك مجمل عملنا الزراعـي ، ونأمل أن تتدعم أواصر التعاون بيننا خلال السنوات القادمة .

أيـها الاخـوة ،

في ختام كلمتي هذه أتقدم لكم بالشكر والتقدير على إتاحتكم لـي هذه الفرصة للتحدث إليكم وإنني اذ ارجو لندوتكم التوفيق والنجـاح أؤكد لكم عزمي على متابعة مناقشاتكم والحرص على تنفيذ ما تخرجـون به من توصيات من أجل مستقبل افضل لمؤسساتنا البحثية فـي هذه البلاد .

اكرر شـكري والسـلام عليكم ورحمة الله وبركاته .

Opening Address by Dr. Hassan Fahmi Jumah, Director General, Arab Organization for Agricultural Development

معالى الاخ الدكتور الفاتح التجانى — وزير الزراعة والموارد الطبيعية

معالى الاخ البروفسير الشيخ محجوب جعفر — وزير التربية والتعليم العالى والبحث العلمى

سعادة المستر هوارد اليوت — نائب مدير الخدمة الدولية للبحوث الزراعية الوطنية

الاخوة المشاركون فى الحلقة الدراسية

الساده الضيوف الافاضل

يسعدنى كثيرا بأسم المنظمة العربية للتنمية الزراعية أن أرحب بكم ونحن نفتتح بعون الله وتوفيقه أولى الحلقات الدراسية لمشروع تقوية ادارة البحوث الزراعية فى الاقطار العربية والذى تضطلع بتنفيذه المنظمة العربية للتنمية الزراعية والخدمة الدولية للبحوث الزراعية الوطنية ISNAR . وهذه الحلقة الدراسية والتى نعقدها خلال هذه الايام فى الخرطوم تأتى فى واقع الامر ضمن عدة حلقات اقليمية وقطرية تأمل المنظمة والاسنار من خلالها فى وضع استراتيجية عربية لتطوير نظم البحوث الزراعية فى الاقطار العربية وصولا للارتقاء بهذا القطاع وتحقيق الامن الغذائى المنشود لها . وتأتى دراسة حالة السودان كأولى الحلقات فى سلسلة دراساتنا فى هذا المضمار والتى نسعى لتطبيقها فى كافة الدول العربية وأملنا كبير أن يتم انجازها وفق ما هو مخطط له .

وكما تعلمون أيها الاخوة الافاضل فأن الاقطار العربية وبرغم مرور أكثر من عقدين من الزمان على الاستقلال السياسى لمعظمها وعلى الرغم من اتجاه الاقطار العربية الى تنمية اقتصادياتها وتحقيق سيطرتها على مواردها الطبيعية وعلى الرغم من تسارع النمو الاقتصادى فى عدد من الاقطار العربية خلال السنوات الاخيره فأن هناك العديد من المظاهر العامة التى تتصف بها الاقتصاديات العربية منها التخلف الواضح للقطاعات الزراعية قياسا بغيرها من القطاعات الاقتصادية الاخرى على الرغم من أن هذه القطاعات تمثل مصدرا للرزق لاكثر من ٥٣٪ من السكان العرب كما تضم حوالى ٤١٪ من القوى العاملة فى جميع المجالات الامر الذى سبب انخفاض متوسط دخل الفرد وعدم قدرة هذا القطاع على توليد النواتج الزراعية اللازمة للنمو الحضارى وما يتبعه من النمو فى القطاعات الاقتصادية الاخرى كالقطاع الصناعى والخدمى .

ويكفى للدلالة على ذلك أن معدل النمو السنوى للانتاج الزراعى وخاصة الغذائى منه لم يتعد نحو ٢٪ فى الوقت الذى يتصاعد فيه الاستهلاك الغذائى بحوالـــى ٥ ٪ سنويا وذلك تأثرا بالارتفاع النسبى فى معدلات تزايد السكان العرب والبالغ حوالـى ٢ر٨٪ سنويا هذا بالاضافة الى زيادة الدخول الفردية وازدياد الوعى العلمى الثقافى للمواطنين العرب .

أن برامج التنمية الزراعية فى الدول العربية تواجه العديد من المعوقــات التى تحد بصورة كبيرة من معدلات النمو فى الانتاجية الهكتارية من ناحيـــة ومدى القدرة على توسيع الرقعة الزراعية أو المحصولية من ناحية أخرى . وبصفــة عامة فانه على الرغم من تباين درجة معوقات التنمية الزراعية بين الدول العربيــة الا أنها تتفق جميعا فيما تحدثه من آثار سلبية فى معدلات التنمية الزراعيـــة بالدرجة التى يمكن معها اعتبار هذه المعوقات فى مجملها معبرة عن الفجوة الحضاريــة التى تعيشها معظم الاقطار العربية فى الوقت الحالى . ولا نود التعرض هنا لتفصيـل المعوقات العديدة الطبيعية منها والتكنولوجية والاقتصادية والمالية والتنظيميـة وغيرها التى تحد من مسار نمو التنمية الزراعية فى الاقطار العربية الا أن الحقيقة تظل ماثلة بأن تحقيق متطلبات التنمية الزراعية وتطوير قطاعاتها لا يتم فقــط بالاعتماد على الزراعات التقليدية بل يتم ذلك بزيادة فعالية عناصر الانتاج وذلك بتحسين نوعيتها .

لقد كان من أهم آثار نتائج الابحاث على التنمية الزراعية ،على المستــوى العالمى ، السيطرة على الانتاج عن طريق زيادة المعرفة بالامور الوراثية والتغذيــة والبيئة ، كما استحدثت أنواع جديدة من الحبوب عالية الانتاج احتلت مكان الانواع متدنية الانتاج . ويمكن تلخيص أهم ما قدمته نتائج الابحاث للتنمية الزراعيـــة على المستوى العالمى بما يلى :-

١ - تحسين استعمال المعرفة المتوفرة عن طريق تطبيقها بشكل أكثر كفاءة وعلـى نطاق واسع من قبل المزارعين .

٢ - اكتشاف ونشر المعرفة والرسائل والنظم الجديدة التى ترفع من انتاجيـــة الموارد المستعملة .

٣ - تغيير انماط الانتاج الزراعى حسب التغيرات التى حصلت فى الاسواق الزراعية .

أيها الاخوة الافاضل

على الرغم من توفر وتقدم الامكانات المتاحة فى الوطن العربى للتنمية الزراعية والتكامل الزراعى الا أن خطط التنمية القطرية وبالرغم من الجهود الكبيرة التى بذلتها معظم الاقطار العربية فى مجال التنمية الزراعية لم تحقق النمو الذى يتناسب مع الامكانيات الوفيره المتاحة ،فكثير من الابحاث والدراسات تشير الى أنه من بين أهم معوقات التنمية الزراعية فى الوطن العربى على المستويين القومى والقطرى هو التخلف التكنولوجى والافتقار الى الابحاث العلمية الموضوعية وعدم توفر التمويل الكافي لها ،يضاف الى ذلك أن هناك فروقا جوهرية بين الطرق والوسائل المتبعة بين الاقطار العربية وعدم ارتباط برامج الابحاث بين الاقطار العربية بروابط واقعية بأولويات المشاكل القومية أو الاقليمية فى كثير من الاحيان ، اضافة الى ضعف التكامل بين المخططين والمنفذين من ناحية ومسئولى الابحاث من ناحية أخرى ، الى جانب ضعف كفاءة بعض نتائج الابحاث فى تحقيق الاهداف المرسومة • والواقع أن شواهد التاريخ تشير الى أن الزراعة قد تقدمت وازدهرت فى الدول الصناعية ،أو المتقدمة بعد الحرب العالمية الثانية بفضل تطبيقات نتائج البحوث العلمية على علوم التربة والاسمدة وموارد المياه والبذور المحسنة ومبيدات الحشرات والامراض النباتية والميكنة الزراعية ،اضافة للارتفاع بالمستوى الفنى للعاملين فى القطاع الزراعى بكافة مستوياته • فأزدادت بذلك الانتاجية فى الاراضى الزراعية كما أدخلت اراضى جديدة فى الزراعة ،ففى المراحل الاولى لفترة ما بعد الحرب العالمية الثانية ،ركزت الدول المتقدمة كثيرا فى خططها التنموية على تطوير قطاعاتها الزراعية واعتمدت كثيرا فى ذلك على توجيه اجراء البحوث الزراعية لايجاد الحلول للمشاكل التى يواجهها المجتمع الزراعى • كما عملت هذه البحوث على تطوير الاساليب الزراعية المتبعة وادخال استعمال الاصول والانواع الجيدة والجديدة الى مناطق الانتاج • الاهم من كل ذلك أن هذه الدول أهتمت كثيرا فى وضع نتائج هذه البحوث أمام المزارع بشكل يسمح له بتطبيق هذه النتائج والاستفاده منها بشكل رئيسى فى زيادة انتاجية الوحدة الزراعية وبالتالى الى زيادة الانتاج القومى •

واذا نظرنا من الناحية الاخرى الى الدول العربية لوجدنا أنها بعد الحرب العالمية الثانية وبعد حصولها على الاستقلال قد حاولت تطوير قطاعاتها الزراعية غير أن اعتمادها على البحوث الزراعية كوسيلة من أهم الوسائل لتطوير هذه القطاعات كان قليلا حيث ركزت على استيراد التكنولوجيا من البلاد المتقدمة لحل مشاكلها الزراعية وخاصة انخفاض الانتاجية

بدل القيام بأجراء البحوث لايجاد الحلول المناسبة بها والملائمة لطبيعة أرضهـــا ومواردها المناخية . هذا بالاضافة الى نقص الموارد لدى بعض الدول العربية والذى لا يسمح لها بأستثمار الاموال الكافية للقيام بالنشاطات البحثية المطلوبة.

الاهم من كل ذلك أن العلاقة بين الباحثين ومؤسسات البحث العربية من جهة وبين المجتمع الزراعى ضعيفة مما أدى الى انخفاض مستوى الاستفادة من نتائج هذه البحـوث ولذلك نجد اعدادا كبيرة من البحوث الزراعية التى أجريت خلال سنوات ما بعد الحـرب انتهت بتقرير نشر بطريقة علمية وغير عملى بحيث لم يستطع المزارع تطبيق نتائجهـا وبالتالى عدم الاستفادة منها . يضاف الى جميع هذه المشاكل مشكلة عدم التنسيق بيـن الباحثين ومؤسسات الابحاث فى البلد نفسه مما يسبب التكرار فى اجراء كثير مـن الابحاث لنفس المشكلة أو الموضوع وهذا يشكل ضياع وهدر الموارد وطاقات الباحثيـن هذا على المستوى الوطنى ،فما هو وضع الابحاث على المستوى القومى .

أن هناك قناعة عامة بوجود تناثر وعدم تنسيق بين مؤسسات الابحاث الزراعيـة فى الوطن العربى ، يضاف الى ذلك عدم كفاءتها مما يترتب عليه عدم تمكنها من مواكبة احتياجات العصر عن حل مشاكله العديده والمتزايده هذا بالاضافة الى أن الموارد المادية والبشرية غير متساوية التوزيع فى هذه البلدان مما يشكل عقبة فى تنفيذ أى من البرامج الطموحة لذوى الموارد المحدودة . لذلك يتطلب تضافر الجهود لدعم مؤسسات البحـث العلمى والتوسع بها لزيادة امكانياتها وتخصصاتها وهذا غير ممكن على الصعيد القطرى فقط بل يحتاج الى عمل وجهد عربى مشترك حيث تستطيع الدول العربية ذات الامكانيـات المادية الكبيرة مد يد المساعدة فى مضمار الابحاث الى تلك الدول ذات الامكانيـات الفنية والخبرات الواسعة . وبذلك يمكن تأمين الموارد المادية والبشرية لتنفيـذ برامج الابحاث لتطوير القطاعات الزراعية بالاضافة الى قيام تنسيق بين مؤسسـات الابحاث العربية على المستوى الوطنى والقومى .

أننا لا نرد أن نطيل عليكم فبين أيديكم عمل كبير يرنو الى جهودكم المخلصـة لفحصه وتحديد المعالم الايجابية فيه وهو عمل بذل فيه فريق العمل جهدا مخلصـا دؤوبا حتى ظهر بهذا المستوى اللائق المشرف .

كما أننا لا نود أن نختتم حديثنا دون أن نوجه الشكر العميق لمنظمة الخدمـة الدولية للبحوث الزراعية الوطنية (الاسنار) ولمديرها العام المستر فون ديـر

أوستن على جهودها المشكورة فى تقديم العون والمساعدة لترقية نظم البحوث الزراعية فى الاقطار العربية والشكر موصول بصفة خاصة للدكتور غازى الحريرى منسق برنامج تقوية ادارة البحوث فى الدول العربية ،على جهوده المميزة التى بذلها فى تنفيذ هـــذا البرنامج .

بارك الله فيكم وسدد على طريق الخير خطاكم .

والسلام عليكم ورحمة الله تعالى وبركاته ،

Opening Address by Dr. Howard Elliott, Deputy Director General for Research and Training, International Service for National Agricultural Research

Your excellency, Dr. El Fatih El Tigani, Minister of Agriculture and Natural Resources;

Your excellency, Dr. El Sheikh Mahjoub Jaffar, Minister of Higher Education and Scientific Research;

Dr. Saad Abbadi, Chairman of the National Council for Research;

Dr. Hassan Fahmi Jumah, Director General, AOAD;

Deans of Faculties and Polytechnic Institutes;

Distinguished Directors of Research;

Fellow participants.

On behalf of ISNAR's Director General, Mr. Alexander von der Osten, let me express how pleased we are to be with you today to discuss the draft study of the Agricultural Technology Management System in the Sudan. We emphasize at the outset that the study has been a collaborative one involving many parties:

* a study team composed of representatives from the Ministry of Agriculture and Natural Resources, the Agricultural Research Corporation, and the Faculty of Agriculture of the University of Khartoum;

* a support team from the Arab Organization for Agricultural Development;

* various staff members from ISNAR, bringing different specializations to the study.

The whole effort was made possible by the Minister of Agriculture who, through his willingness to allow such a study to go ahead, ensured the collaboration of institutions coming under his Ministry.

It is through the formation of partnerships such as these that ISNAR will be able to fulfill its mandate of strengthening National Agricultural Research Systems (NARS).

It is also necessary to note that the study approach called for a workshop of interested parties to provide critical comment on the approach, the accuracy of its findings, and the consistency of its recommendations.

ISNAR and Its Work

Let me say a few words about ISNAR.

ISNAR was created by the Consultative Group on International Agricultural Research (CGIAR) in 1980.

ISNAR is somewhat unique in the CGIAR system: the system is made up of 11 technical institutes with commodity or regional mandates, and two institutes - IFPRI and ISNAR - dealing explicitly with policy and institutional issues.

ISNAR was set up on the recommendation of a task force which saw a need for an organization which had as its principal task the strengthening of national agricultural research systems (NARS).

Over the eight years that ISNAR has been in operation, it has defined clearly what it means by "strengthening NARS". In its recent Strategy Statement ISNAR has expressed its goal as follows:

> "To assist developing countries to improve the efficiency and the effectiveness of their national agricultural research systems through enhanced capacity in the areas of research policy, organization, and management."

This goal statement is worth looking at more closely. First, we distinguish between effectiveness and efficiency. Effectiveness relates to whether or not the system is having the desired impact on national goals ("doing the right things"), while efficiency relates to the way in which the system uses and manages the resources that are put at its disposal. One can think of institutes (or systems) that have made major breakthroughs but have not used resources efficiently; one can also think of systems where scientists work very hard and use resources efficiently but are working on the wrong problems from society's point of view. In the long run, a system must be both efficient and effective for it to be sustainable and retain the confidence of government, its clients, or its donors.

Second, we indicate that ISNAR is engaged in system-building efforts. This implies both a systems approach and long-term collaboration with individual systems.

Finally, we have defined our areas of system building as involving all three areas of agricultural research policy, organization, and management.

In order to carry out its system-building activities, ISNAR has three mutually supporting programs:

Advisory Service
Research
Training

Each program has its role to play in working with national agricultural research systems.

> The Advisory Service program attempts to improve research management directly through its reviews of systems, planning, and implementation activities.

Research attempts to develop diagnostic instruments which can be used in looking at management problems as well as improved management tools which can be used by NARS managers.

A Training and Conference program seeks to share the lessons of our other programs with a broader audience than would be reached in an effective way by each of the other programs working in isolation.

Although for internal development we organize our programs in this way, at the level of NARS they are one integrated program to strengthen systems.

ISNAR in the West Asia North Africa (WANA) Region

All three programs have been active in the West Asia and North Africa (WANA) Region. A few examples will illustrate our collaboration.

Shortly after its creation, ISNAR became involved in the WANA region through reviews in Somalia (1983), Morocco (1984), and Tunisia (1985).

In some cases, limited reviews were undertaken of training needs (ARC, Sudan,1983) and human resources (Jordan, 1985).

These diagnostic efforts were just the start of system-building activities: the reviews of Tunisia and Morocco were followed by the preparation, in conjunction with national teams, of long- and medium-term research plans.

As time has progressed, so has the nature of ISNAR's collaboration. An essential part of implementing a research strategy is the development of improved programming and budgeting systems to make the link between objectives sought and resources required. Through work with countries in the region, we have learned that this can only be done at the initiative of national managers, and local expertise must be at the forefront of developing such systems. They cannot be developed as "turnkey systems".

Through national and regional conferences ISNAR has kept its lines of collaboration open to new initiatives. National workshops have been held in Egypt (1986), Syria (1987), and Sudan (1987, 1988) dealing with critical themes of priority setting, program budgeting, monitoring and evaluation, and human resource management.

ISNAR has been associated with ICARDA and FAO in the establishment of AARINENA (Association of Agricultural Research Institutes in the Near East and North Africa) as a forum for the exchange of experience.

ISNAR in the Sudan

A special relationship has grown up between ISNAR and the Sudan since the review of ARC training needs in 1983 which was published in 1984.

A series of visits has kept contacts up to date:
collaboration with AOAD has led to the development of a proposal for SARMAC -- Strengthening Agricultural Research Management in Arab Countries.

The SARMAC project is aimed at assisting NARS in the region to have a greater impact on their farmers. As a regional organization AOAD was particularly interested in helping to generate the comparative information we all need to study ways to improve systems throughout the region.

The Manager of the Agricultural Research, Extension, and Training project (ARETP) visited ISNAR for three weeks to consult staff and other in-house resources on issues of research project management. During this time he developed a five-year program of collaboration between ISNAR and ARC within the framework of the World Bank project.

This visit was followed by that of the Deputy Director General of ARC, who worked with staff on program budgeting. His visit was followed up by an introductory workshop on program budgeting, monitoring and evaluation, and human resource management in late 1987. In the current year, collaboration with ARC will go into greater depth on practical development of program budgeting.

The purpose of our being here today, however, is the review of a draft report on the Agricultural Technology Management System of the Sudan. This workshop is formally part of a process which brought together a team of experienced Sudanese scientists, an international center, and a regional organization to produce both a diagnosis of a system and discussion of alternatives for system improvement.

We will have the opportunity to discuss the logic of the framework within which the system is being analyzed, the value of the tools which are used, the accuracy of the information generated, and the translation of diagnosis into recommendations.

Let me conclude by saying how grateful ISNAR is for the quality of the collaboration we received from Dr. Hamdoun, Dr. El Sheikh, and Dr. Ahmed and with the support from the ministries and institutions involved, all of whom supplied information and received the team graciously. Collectively, we are all grateful to AOAD for its support to the work of the local team. I look forward to the results of a frank discussion of the report so that we can improve the analysis and stimulate constructive debate on ways to improve the system we have been studying.

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Part 2

Report to
the Minister of Agriculture and
Natural Resources,
Republic of the Sudan

THE AGRICULTURAL TECHNOLOGY MANAGEMENT SYSTEM IN THE SUDAN:

A Methodology and Test Case

THE AGRICULTURAL TECHNOLOGY MANAGEMENT SYSTEM IN THE SUDAN: A Methodology and Test Case

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Acknowledgements

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Thanks are also expressed to the managements of agricultural research, and university and polytechnic institutions and to all members of the academic, research, and research support staff for their assistance and help.

Acronyms

ABS	Agricultural Bank of Sudan
ACSAD	Arab Center for the Studies of Arid Zones and Dry Lands
ADB	African Development Bank
ADFD	Abu Dhabi Fund for Development
AFESD	Arab Fund for Economic and Social Development
AFI	Agricultural Field Inspectorates
AHCANR	Abu Haraz College of Agriculture and Natural Resources
ANCANR	Abu Naama College of Agriculture and Natural Resources
AOAD	Arab Organization for Agricultural Development
APCEU	Agricultural Production Corporations Extension Units
APPC	Animal Production Public Corporation
APRA	Animal Production Research Administration
ARC	Agricultural Research Corporation
AVRDC	Asian Vegetable Research and Development Center
BNAPC	Blue Nile Agricultural Production Corporation
BNIARDP	Blue Nile Integrated Agricultural and Rural Development Project
CA	Constituent Assembly
CB	Commercial Banks
CHS	Council of Head of State
CIAT	Centro Internacional de Agricultura Tropical
CIBC	Commonwealth Institute of Biological Control
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CIP	Centro International de La Papa
CM	Council of Ministers
DAEFE	Department of Agricultural Engineering, Faculty of Engineering, University of Khartoum
DANIDA	Danish International Development Agency
DATS	Department of Agricultural Technicians, Shambat
DFSS	Department of Forestry Studies, Soba
DSRC	Development Studies and Research Centre, University of Khartoum
DVAHK	Department of Veterinary and Animal Husbandry, Kuka
EAPC	Equatoria Agricultural Production Corporation
ECA	Economic Commission for Africa
EEC	European Economic Community
FACC	Foreign Agrochemical Companies
FAO	Food and Agriculture Organization
FASUG	Faculty of Agricultural Sciences, University of Gezira
FAUK	Faculty of Agriculture, University of Khartoum
FF	Ford Foundation
FINIDA	Finish International Development Agency
FNRESUJ	Faculty of Natural Resources and Environmental Studies, University of Juba
FSC	Foreign Seed Companies
FVS	Faculty of Veterinary Sciences, University of Khartoum
Farmers	Private farmers
Fishermen	Fishermen
GAPC	Gash Agricultural Production Corporation
GTZ	German Agency for Technical Cooperation

HRU	Hydrobiological Research Unit, University of Khartoum
IAEA	International Atomic Energy Agency
IAPUK	Institute of Animal Production, University of Khartoum
IBPGR	International Board for Plant Genetic Resources
IBRD	International Bank for Reconstruction and Development
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRAF	International Council for Research in Agroforestry
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Centre
IESUK	Institute of Environment Studies, University of Khartoum
IFAD	International Fund for Agricultural Development
IITA	International Institute for Tropical Agriculture
ILCA	International Livestock Center for Africa
ILRAD	International Laboratory for Research on Animal Diseases
IMF	International Monetary Fund
INTSOMIL	International Sorghum and Millet Program
INTSOY	International Soybean Program
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
JMRDP	Jebel Marra Rural Development Project
KDF	Kuwaiti Fund for Development
KFW	German Bank for Development
LMMC	Livestock and Meat Marketing Corporation
LVRA	Laboratories and Veterinary Research Administration
Livestock	Livestock owners
MANR	Ministry of Agriculture and Natural Resources
MAR	Ministry of Animal Resources
MCCS	Ministry of Commerce, Cooperation and Supply
MFC	Mechanized Farming Corporation
MFEP	Ministry of Finance and Economic Planning
MI	Ministry of Irrigation
MIN	Ministry of Industry
NAEA	National Agricultural Extension Administration
NAPC	Northern Agricultural Production Corporation
NCR	National Council for Research
ND	Netherlands Development Agencies
NHAPC	New Halfa Agricultural Production Corporation
NMAPC	Nuba Mountains Agricultural Production Corporation
NMRDP	Nuba Mountains Rural Development Project
NSAMANR	National Seed Administration, Ministry of Agriculture and Natural Resources
NTC	National Tobacco Company
OAU	Organization of African Unity
ODA	Overseas Development Administration
OPEC	OPEC Fund for International Development
PAEA	Planning and Agricultural Economic Administration, Ministry of Agriculture and Natural Resources
PMAPC	Private and Multilateral Production Companies
PPI	Private Poultry Industry
RAEU	Regional Agricultural Extension Units
RAPC	Rahad Agricultural Production Corporation
RF	Rockefeller Foundation

SAPC	Suki Agricultural Production Corporation
SAREC	Swedish Agency for Research Cooperation with Developing Countries
SCC	Sudan Cotton Company
SDF	Saudi Fund for Development
SDMANR	Service Department of the Ministry of Agriculture and Natural Resources
SDMAR	Service Departments of the Ministry of Animal Resources
SEUGB	Socio-Economic Unit, Sudan Gezita Board
SF	Abdelhameed Shuman Foundation
SGB	Sudan Gezira Board
SOSC	Sudan Oil Seed Company
SUER	Socio-Economic Unit, Rahad Agricultural Corporation
Sug.Com.	Sugar Companies
TAPC	Tokar Agricultural Production Corporation
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
VEA	Veterinary Extension Administration
WI	Winrock International
WNAPC	White Nile Agricultural Production Corporation
WSDP	Western Savannah Development Project

Executive Summary

AOAD and ISNAR have jointly developed the SARMAC project (Strengthening Agricultural Research Management in Arab Countries) to assist national agricultural research systems (NARS) in their efforts to improve the level of agricultural technology used by farmers. The project constitutes a field study of selected agricultural research management issues in Arab countries and a series of agricultural research management training workshops at country and regional levels.

To implement the field study, a common methodology has been developed for the review, by national study teams, of agricultural research in each of the Arab countries and the identification of opportunities to improve research policy obligation and management.

The basic analytical construction of the methodology is the Agricultural Technology Management System (ATMS). The methodology begins with a number of hypotheses about the process of technological change in agriculture in the Arab countries and presents a number of analytical tools for identifying points of intervention by governments and donors in order to improve policy, organization, and management of agricultural research in the region.

These analytical tools were described and presented to a local study team in the Sudan to be used for collecting and analyzing data with support from AOAD and ISNAR.

The present report on the Sudan ATMS is the first in a series of ATMS Arab Country reports. It is the outcome of the joint efforts of a Local Study Team, AOAD, and ISNAR. The Local Study Team of three scientists was selected to represent multi-organizations (ARC, MANR, and FAUK) and multi-disciplines (biology, agricultural economics, and agricultural planning).

After the Local Study Team was briefed on the techniques and procedures of ATMS, the team collected and analyzed data on socio-economics and the importance of agriculture in Sudan; identified institutes and groups and their roles and mechanisms in the Sudan ATMS; and collected data on agricultural research institutions and human resources. Further analysis and writing up were carried out at ISNAR in order to evaluate the methodology and produce the final draft of the present report on the Sudan ATMS. After holding the final round of discussions with AOAD staff and the Local Study Team, the present report has been finalized. A national workshop will be held to discuss findings and recommendations.

Agricultural research in Sudan plays a key leadership role in developing and adapting technology required to meet the needs of agricultural development. To achieve production targets the Sudan will need to strengthen its present agricultural research capabilities for planning and implementing system-building strategies in agricultural research policy, organization, and management.

At the national level, particular attention will need to be given to ensuring that research policies are adequately oriented toward agricultural sector objectives and overall development and societal goals. At the same time, agricultural research should contribute to developing agricultural policies by providing analytical studies which will influence decision making concerning these policies. To achieve these objectives the research system needs institutional mechanisms for basing agricultural research on sound economic considerations at the national level. Thus, it has been proposed that a centralized authority to prioritize research at the national level be established in the form of a council. A proposed name for this council is the "Sudan Agricultural Research Council" (SARC). This proposed council could combine functions and responsibilities in agricultural research policy formulation and research coordination at the national level of the present ARC council and the Agricultural Research Council of the NCR. Functions and membership are discussed in Chapter II and Chapter III, part II.

The absence of a comprehensive national agricultural research policy has led to fragmentation of technology generation, assessment, and transfer programs. Therefore, there is need for systematic planning and programming of agricultural research in the Sudan.

The planning and programming of agricultural research is an ongoing goal-oriented process involving decision making and optimizing means and use of resources. Once program priorities, resource allocation, and strategic planning at the macro level are defined by the proposed SARC, it is at least as important to identify long-term priorities for research activities at the national, institute, and program levels. Thus, the research institutions in Sudan need to determine their long-term research programs and assure their relevance and effectiveness. A process for determining long-term program is described in Chapter II.

An annual programming cycle is proposed to confirm quality and relevance of research and improve research programming for establishing, evaluating periodically, and adjusting research programs, projects, and operations.

Once research programs have been determined on the basis of research priorities, implementing research programs involves organization of human resources to carry out the research activities, and provision of funds and facilities to enable them to function efficiently and produce and communicate research results effectively.

Establishing a national research policy and developing a long-term research program will help maintain research priorities and to provide a framework for allocating financial resources from the Government and donor sources and using them most effectively.

Planning and development of human resources for agricultural research should be organized at the national and institutional levels to deal with future research program needs, organizing in-service training, including research management training, developing good incentive structures, including career plans for research staff, and seeking fellowship for non-degree and post-graduate degree training in the Sudan and abroad.

Strategies should be developed for use of buildings and land, maintenance and repairs, developing equipment, supplying and purchasing, developing physical resource personnel, and centralizing some services at the national, institutional, and research station levels.

It has been proposed that central facilities and services at the national level could include establishing a national agricultural library and documentation center, including a central library, publication and information, computer and statistics, and conference facilities; and establishing a national or institutional center(s) for maintenance and repair of scientific instruments and sophisticated equipment.

Regarding linkages between the technology transfer system and users, the proposed annual programming cycle for each institute will ensure participation of farmers, extension, development agencies, etc. in the programming process.

The need for developing a seed policy program in the Sudan is confirmed to ensure that technology generation and transfer efforts have achieved their objectives.

CHAPTER I

National Team Role in Agricultural Technology Management Analysis

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CHAPTER I

NATIONAL TEAM ROLE IN AGRICULTURAL TECHNOLOGY MANAGEMENT ANALYSIS. CASE STUDY: THE SUDAN

Introduction

The objective of the SARMAC (Strengthening Agricultural Research Management in Arab Countries) project is to assist National Agricultural Research Systems (NARS) in their efforts to improve the level of agricultural technology used by farmers. A basic hypothesis is that strengthening the national agricultural research capacity in these countries is an important element in this process.

The basic analytical construct proposed is the Agricultural Technology Management System (ATMS). The methodology begins with a number of hypotheses about the process of technological change in agriculture in the Sudan and proposes analytical tools for identifying points of intervention by governments and donors in order to improve the policy, organization, and management of agricultural research in the region.

The ATMS study in the Sudan conducted by AOAD/ISNAR had the following objectives:

1) to examine ATMS and make an independent appraisal of the technology-generating, transfer, and adoption sub-systems;

2) to provide Government and, in particular, agricultural research managers, with an analysis of the ATMS, focusing on key agricultural research management issues;

3) to identify ways and means of strengthening agricultural research policy, structure, and organization;

4) to be a pilot study for a series of 21 reviews which will eventually cover all national agricultural research systems (NARS) management in the Arab countries;

5) to make recommendations for future improvements in both structure and mechanisms for performance of key functions of the system and key internal functions of institutions in the system.

A. Brief History of AOAD

In 1970 the Council of the League of Arab States approved the establishment of the Arab Organization for Agricultural Development (AOAD). In 1972 the organization, as a specialized agency, commenced its activities at its headquarters in Khartoum, Sudan; thus confirming the role of Sudan in food production in view of its immense agricultural resources.

Member countries of AOAD are Jordan, United Arab Emirates, the State of Bahrain, Tunisia, Algeria, Djibuti, Saudi Arabia, Sudan, Syria, Somalia, Iraq, Sultanate of Oman, Palestine, Qatar, Kuwait, Lebanon, Libya, Egypt, Morocco, Mauritania, Yemen Arab Republic, and Peoples' Democratic Republic of Yemen.

The objectives of AOAD are:

1) developing natural and human resources available in the agricultural sector and improving ways and means for their utilization on a scientific basis;

2) upgrading agricultural productivity covering both the plant and animal sectors and realizing efforts leading to integration among Arab countries;

3) securing facility of exchange of agricultural products among Arab countries;

4) helping to boost agricultural production and achieve self-sufficiency;

5) supporting the establishment of projects and agro-industries;

6) improving the standard of living of those engaged in the agricultural sector.

B. Local Study Team Formation in the Sudan

The policy of the AOAD Board of Management is to appoint national teams when conducting scientific, technical, and social studies pertaining to food, agriculture, and rural community development in the Sudan. AOAD determines the terms of reference and contracts teams to conduct the study with the project leader authorized to appoint short-term experts. Team responsibilities are data compilation, analysis, drafting of a manuscript, and report finalization upon AOAD approval of the manuscript.

In order to conduct the present study on ATMS, the importance of integration between AOAD/ISNAR and the local team was realized as being essential to its success. A local team composed of formal representatives from the Ministry of Agriculture and Natural Resources, the Agricultural Research Corporation (ARC), and the Faculty of Agriculture, University of Khartoum was selected after consultation between AOAD and ISNAR. The local team members chosen were:

1) Professor Abdalla Mohamed Hamdoun, National Coordinator for Botany and Plant Pathology, ARC, team leader;

2) Dr. Abdel Moneim Mohamed El Shiekh, Director General, Planning and Economics Administration, Ministry of Agriculture and Natural Resources;

3) Dr. Ahmed Humeida Ahmed, Agricultural Economist, Faculty of Agriculture, University of Khartoum.

This team was supported by:

AOAD

1) Dr. Hassan Fahmi Jumah, Director General
2) Dr. Mohamed O.M. Salih, Deputy Director General
3) Dr. El Sadig Azrag, SARMAC Project Coordinator

ISNAR

1) Dr. Howard Elliott, Deputy Director General for Research
2) Dr. Ghazi Hariri, SARMAC Project Coordinator
3) Dr. Byron Mook, Senior Research Officer
4) Dr. Paul Marcotte, Visiting Research Fellow

The composition of the team clearly showed that the selection process was carefully considered by AOAD/ISNAR. The team was multi-disciplinary in nature, as it included a biophysical scientist with long experience in the history and operation of agricultural research institutions in the country; an agricultural economist with long experience in the economics of the agricultural sector and operations of universities and polytechnics; and a planning economist experienced in development plans and agricultural policy issues of the Sudan. Moreover, the local team was multi-organizational, representing ARC as a semi-autonomous entity responsible for research policy formulation and program implementation, the Ministry of Agriculture and Natural Resources as a major policy-making body in the country, universities as educational institutions backing the ATMS, AOAD as a regional organization, and ISNAR as an international organization.

The complementarity of the team was quite evident because ISNAR has developed the methodology, explained it to the local team, helped in identifying external ATMS organizations, and carried out the computer analysis and final reporting. The AOAD project coordinator provided facilities for data collection, organized meetings, made travel arrangements, and assisted the team by making available his personal experience. The outcome of the study is therefore a team effort from begining to end. The biophysical scientist prepared the background information on agro-ecological characteristics, production systems, yield performance and major crops, livestock and poultry, country maps, and organizational structure of the national agricultural research system. The agricultural planner developed background information and country indicators pertaining to the share of agriculture in GDP, agricultural policy and goals of national development plans, agricultural development performance, and institutions of agricultural services. The agricultural economist covered the sections on population, technology utilization, credit, and marketing.

C. Methodology

The methodology used to test the effectiveness of ATMS is a four-part approach consisting of:

a) Background/Overview/Performance Indicators;
b) Functional Analysis;
c) Institutional Analysis;
d) Human Resource Inventory.

a) Background/Overview/Performance Indicators

In this part, information on agro-ecological characteristics of the Sudan, population, production systems, agricultural policy and agricultural goals of the current national development plan and performance of the agricultural sector, overview of agriculture growth and technological change, structure of agricultural research institutions, and country development indicators was obtained through literature surveys, interviews, and discussions with informed personnel in the various ATMS institutions and team members' experience and knowledge.

b) Functional Analysis

All institutions involved in the ATMS system were identified by the local team. These include:

i) local "technology sector", with its subsectors (the technology-generating subsector, the technology-transfer subsector, and the technology-using subsector);

ii) the "politico-bureaucratic structure", composed of formal representatives of the Government and decision makers and the channels through which interests of all groups in the ATMS are made known to policy makers;

iii) the "external sector", composed of donors, international technology-generating institutions, international technology-transfer institutions and multinational firms engaged in technology generation, transfer, and adoption;

iv) institutions which influence the underlying "structural conditions", i.e., world markets for inputs and outputs and the resource base of the country;

v) institutions which influence the "policy environment".

The purpose and role of each of these institutions was defined. Its level of involvement in the 13 key functions which an ATMS must perform or influence was identified. The mechanism by which these institutions perform or influence these functions is explained. The 13 key functions considered include macropolicy, intersector allocation, human resources, political support, external support, sector goals, resource allocation, research strategy, technology generation, technology transfer, support services, impact evaluation, and marketing.

c) Institutional Analysis

Formats requesting information about the structure of various research institutions, their funding, human resources, principal problems, allocation of resources among commodities and themes, organization and management, output, planning, agreements with other organizations, evaluation of expenditure and scientific staff, and training targets were prepared by ISNAR. These formats were distributed with supporting letters from the Minister of Agriculture and the Director General of AOAD to the directors of research institutions and deans of agriculture faculties and polytechnic institutes who provided the required information from institutional records.

d) Human Resource Inventory

Formats requesting background information on scientists, their education, employment, remuneration structure, work experience, current research projects, publications, training needs, membership in professonal societies, awards and achievements, and participation in conferences, workshops, and seminars were prepared by ISNAR. They were distributed with supporting letters from the Minister of Agriculture and the Director General of AOAD by a team of supporting staff who made direct contacts with individual scientists in the research institutions and the academic staff members of agricultural faculties and polytechnic institutes.

D. Information Consolidation

Collection of the required data and information for the purpose of ATMS necessitated interaction and collaboration between team members, team members with AOAD and ISNAR, and team members with various people with different backgrounds and experience, i.e., research scientists, university professors, policy makers and planners, statisticians, administrative and finance personnel, and technicians. In some instances the response to the human resource inventory was not according to expectations due to reluctance and/or passiveness by scientists. However, with continued follow-up by the local team and support staff the response was quite satisfactory.

In certain cases information was not readily available, e.g., size distribution of agricultural holdings and areas of different types of agricultural production systems. In order to resolve this difficulty it was necessary to resort to different techniques using the existing information. In other cases, information was not available, and local team members resorted to personal judgement and assessment.

The enormous amount of information collected in this study needs microcomputer analysis in order to present the information in a document. The computer will be used to store information in a data base format which can be updated as new institutions are created, as the functions of institutions are modified, or as mechanisms for involvement are changed.

E. Feedback

A seminar will be held with joint cooperation between the local team, AOAD, and ISNAR to discuss methodology, conclusions, and recommendations of the ATMS review with representatives of key organizations in the Sudan. This will help participants view their institutions in a wider perspective. Feedback from participants will help in promotion and improvement of methodology, and in determining what steps can be taken in the future. Discussions may also add more institutions and their level of involvement in the ATMS. More information will be included in the system if the ATMS organizations set up a specialized team for collection of new data, analysis and refinement of methodology, and will set up a permanent data base.

F. Country Benefits

The outcome of the ATMS study will benefit the Sudan in the following ways:

1) Detailed background information, overviews, and country development indicators will be of value to biophysical scientists, economists, and planners in the agricultural sector.

2) The study will propose ways and means of expanding and improving research programs which would assist research institutions.

3) Policy makers will be in a position to identify ATMS needs and set priorities that will improve productivity and allocate resources to technology-generating, transfer, and adoption sub-systems.

4) Identification of research priority needs of national programs will encourage donors in decision making on technical and financial assistance to Sudan.

5) It will reveal scientific personnel achievements, shortcomings, allocations, research projects, and training needs.

6) It will display how external and internal institutions influence ATMS and how they can be made more effective.

7) The study will reveal organizational evolution, human resources planning and programming of research, administrative autonomy, national funding, external donor assistance, problems of personnel scales and retention capacity for qualified personnel in the various research institutions.

8) The relative effectiveness of the different research institutions in agricultural policy and development will be determined. This will eventually help in resource allocation.

G. Implications of the ATMS Analysis

The study on ATMS will have implications for the Country Team, the Sudan, AOAD, and ISNAR.

a) The Country Team

The Country Team members have gained an enormous experience on a new methodology ATMS and have learned during the process of data collection and consolidation. This experience will be translated into action. The team will assist in training team leaders from 21 Arab countries on the ATMS methodology. Moreover, the local team will participate in an in-country seminar to discuss methodology, conclusions, and recommendations with representatives of key ATMS organizations. Feedback from participants will assist the local team in refining methodology, identification of new ATMS institutions, and further valuable recommendations. The present team should continue to function as a specialized team in the future as it offers its services in data collection, analysis and refinements in methodology, and setting up a permanent data base at AOAD.

b) The Sudan

Since technology generation and transfer are influenced by the socio-economic environment, the Sudan should give due consideration to the various factors affecting supply and demand for agricultural technology and to the needs of the different groups in the ATMS affected by technology changes. Research institutions in the country need to expand the research programs to include adaptive research, strengthen their linkages with external technology-generating centers, strengthen their linkages with national and external technology transfer institutions, and establish strong linkage with users of technology. The national technology transfer institutions will have to be strengthened by training of personnel, provision of facilities, and upgrading salaries. Achievement of this will necessitate a reform in agricultural policy, planning, and programming within research institutions, provision of adequate human and financial resources, and administrative flexibility. The research policy should therefore be integrated within the agricultural policy, the programs of private research institutions, and users' needs.

A further implication of ATMS is the need for developing an effective scientific interaction between Sudanese scientists and international scientists in publications and international conferences, both of which require additional funding from Government sources, the private sector, or donor organizations. The government should build the capacity to carry out periodical ATMS reviews and study cases based on commodities or production systems.

c) AOAD

The study will achieve the objectives of AOAD through the development of information on national and human resources available in the agricultural sector, improvement of the ways and means of utilization of scientific bases, improving agricultural productivity, helping to boost agricultural production, achieving self-sufficiency, and improving the standard of living of those engaged in the agricultural sector.

Furthermore, implications to AOAD will include contribution to the ATMS study finance, management of the project, follow up of activities and support country training and regional seminars.

d) ISNAR

The study will acheive ISNAR's objectives of strengthening planning, organization, and management capacities of national agricultural research institutions. Future implications will include contribution to the project finance and promotion of training on agricultural research management.

CHAPTER II

Discussion of Main Issues

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CHAPTER II

DISCUSSION OF MAIN ISSUES

A. Background of Sudan's Agriculture

Sudan is a large country, covering nearly 2.5 million km^2, of which 26.7% is desert, 15.5% semi-desert, 47.7% savanna, 9.8% riverine, and 0.3% is mountainous.

Approximately 80% of the population, estimated at 21.6 million in the 1983 census, lives in rural areas. The annual growth rate is 3.1%. About 44% of the population are under 15 years old.

About 60% of Sudan's area is occupied by 11% of the population who are fully or partly nomadic, combining cultivation of subsistence crops and some cash crops with seasonal migration with their herds, along well-defined routes determined by the location of drinking water sources during the wet and dry seasons.

Per capita GNP in 1985 was the equivalent of US$ 375. AGDP represents 30% of the total GDP (1981/82 - 85/86), with an annual growth of 5%. Agricultural products account for about 97% of merchandise exports, and 20% of merchandise imports (Table 1.8 p. 72).

Sudan is one of the few countries in the world with a vast potential for horizontal expansion in crop production. Currently about 10 million ha out of 74 million ha potential arable land are cropped. The rest of the land is pasture land, forests, land under water, and uncultivable land.

The 10 million ha of cropped area consists of about 1.7 million ha in irrigated farming, 4.0 million ha in rainfed mechanized farming, and 4.1 million ha in rainfed traditional farming practiced by small farmers. The rainfed area fluctuates from year to year from about 6.5 to 10.5 million ha, according to the amount of rainfall, and the availability of farming inputs.

The Government owns the five major irrigation schemes (about 90% of the irrigated area). Tenants of an average 8 ha per tenancy are the main farmers of these schemes. The schemes produce all of Sudan's long-staple cotton, 90-95% of its medium-staple cotton, most of its wheat and sugarcane, 40% of its groundnuts, 13% of its sorghum, and 40% of Sudan's vegetables and fruits.

The major field crops are cotton, sorghum, millet, sugarcane, wheat, groundnut, sesame, fruits, and vegetables. Sudan has an enormous wealth of livestock -- cattle, sheep, goats, and camels.

Grain sorghum is the most important cereal food crop. It is grown in about 40% of the total cropped area. In the irrigated sector, 7% of the sorghum area produces 15% of sorghum production -- and in the rainfed area, where the 62% of the total crop comes from, is mechanized farming and 23% is traditional farming. Sorghum yield is low in all three sectors. Irrigated sorghum yields (1080 kg/ha) are double those from mechanized farming (609 kg/ha). The poorest yield is in the traditional sector (447 kg/ha). Improved sorghum varieties cover about 3% of irrigated and mechanized sorghum farming. In the traditional farming sector, there are attempts to establish improved seed production farms.

Wheat is grown under irrigation during October-March in the Northern, Central, and Eastern regions. It occupies about 150,000 ha, with an average yield of about 1218 kg/ha. This low yield is attributed to unfavorable climatic conditions, poor land preparation, inadequate supply of inputs, and delayed sowing. Improved seed is used in about 35% of the wheat area.

Cotton is the main cash crop. It occupies 462,000 ha, and about 88% of it is produced under irrigation. Yield has improved from 770 kg/ha in 1977 to 1640 kg/ha in 1983 in the Gezira scheme. Rainfed cotton yields are much lower and range between 265 and 350 kg/ha.

Groundnut production has increased rapidly in the last decade. Substantial increases have come from increased area planted (about 1 million ha) and improvement in yields. Sudan has become a major groundnut producer, now ranking fourth among producing countries. Forty percent of the production is from irrigated areas. The rest is produced in rainfed areas, mostly in North Kordofan and South Darfur. The average yields are about 1.6 tons/ha in the irrigated area and about 0.528 tons/ha in the rainfed area. The improved varieties are scarecely used.

Sesame is exclusively produced under rainfed conditions in Kordofan, Kassala, and Blue Nile provinces, in a total area of 857,000 ha. The average yield (230 kg/ha) is low. There are attempts to maximize the use of improved varieties.

Sugarcane is produced under irrigation in the Government schemes. Yields are generally low (60-95 tons/ha) in comparison with most sugarcane-producing countries. Improved high-yielding and smut-disease-resistant cultivars have been introduced.

Millet is grown under rainfed conditions in Western Sudan. Small areas, however, are planted in the flush-irrigated Tokar delta. The total area is 1,213,000 ha. Local varieties are grown, and the average yield is low - 297 kg/ha. An improved high-yielding variety has recently been released.

Fababeans (broadbeans) are grown in Northern Region under irrigation on 60,000 ha. Local varieties are grown. High-yielding varieties have been released.

Most farmers use uncertified seed. Certified seed is usually not available to the traditional rainfed sector. Shortage of certified seed in the country is mainly attributed to lack of facilities available to the National Seed Administration.

For cotton, the large production schemes and the Mechanized Farming Corporation is producing cotton seeds needed for cotton farming. It is now producing improved seed of wheat, sorghum, and groundnuts for distribution to the farmers in their schemes. However, production of improved seed needed for mechanized and traditional farming is lacking.

Productivity of livestock is generally low, and this is attributed to inadequate supply of good quality feed and to the nomadic nature of livestock production.

Agricultural development policy

Development of the agricultural sector has always been a concern of the Government, and hence agriculture's share in the development budget has always been the largest, between 25 and 38% during the last twenty years.

The principal objectives of agricultural development plans are:

a) to secure self-sufficiency in food;
b) to earn sufficient foreign exchange through promotion of export of agricultural products;
c) to generate employment for the rural population;
d) to contribute to equal distribution of wealth between different regions;
e) to maintain, conserve, and develop natural resources;
f) to assure sufficient raw materials for local agro-industries.

The objective of food self-sufficiency in staple food has largely been achieved. Sudan is self-sufficient in staple foods - sorghum, millet, edible oil, and meat. Emphasis is placed on achieving self-sufficiency in wheat, producing surplus in sugar for export, increasing export in sorghum, groundnuts, sesame, and meat and live animals. Wheat and wheat flour are the principal imported food items, representing 45% of the total value of imported food, with sugar, rice, tea, coffee, tobacco, and some dairy products constituting the remainder. The projected percentage of self-sufficiency in the year 2000 is: in wheat 100, sorghum and millet 123, edible oils 179, refined sugar 277, red meat 113, and poultry 100.

Concerning objectives c and d, efforts to generate employment and to distribute wealth between different regions are described in detail in Part I of Chapter III.

Objective e, concerning the maintenance, conservation, and improvement of natural resources, acknowledged that deterioration of natural resources, soil degradation, and desertification problems are not only attributed to drought incidents and climatic factors but also to general land misuse. Hence plans for natural resource conservation and development have tended to emphasize the principal notion that land-use be based on its actual capacity. Realization of this has required the availability of up-to-date resource-base maps involving detailed land capability classification which can be used for the formulation of a national land-use plan for agricultural development.

B. Agricultural Research Institutions and Balance of the Research Programs

Agricultural research in the Sudan is being undertaken by various institutions in ministries, universities, councils, agricultural corporations, and bilateral and multilateral agricultural development companies (Chapter III, Parts II and III). Until very recently, crop research has been concentrated in the irrigated sub-sector, particularly on cotton. However, the efforts have now been expanded to include rainfed crops through the Western Sudan Agricultural Research Project.

The Agricultural Research Corporation (ARC) is the major research institution in the country. It is a semi-autonomous national research organization directly responsible to the Minister of Agriculture and Natural Resources, and is responsible for almost all agricultural research in the Sudan. Its research activities are focused mainly on crops, but also include research on forestry, range management, wildlife, fisheries and marine biology, and food processing. ARC has its headquarters at Wad Medani, with five regional stations at Wad Medani (Gezira Research Station), Yambio, Hudeiba, Abu Naama (Kenana Research Station), and Kadugli; nine provincial stations (Rahad, Sennar, New Halfa, Kassala, Shendi, Elobeid, Fasher, Ghazala Gawzat, and Shambat); one commodity station (Guneid Sugar Station); and four national research centers (Food, Forestry, Wildlife, and Fisheries).

The Faculties of Agriculture at the Universities of Khartoum, Gezira, and Juba, and the three Agricultural Polytechnic Institutes are also involved in agricultural research.

Livestock research is the responsibility of the Ministry of Animal Resources. The two departments involved in livestock research are the Animal Production Research Administration (APRA) and the Laboratory and Veterinary Research Administration (LVRA). APRA research activities forms on cattle and sheep breeding, fattening, and nutrition. Its headquarters are at Khartoum, with substations at Shukkaba, Umbenin, El Huda, Ghazala Gawzat, and Atbara. LVRA headquarters are at Suba (Khartoum), and it works mainly on animal health research and production of vaccines.

The Faculty of Veterinary Sciences (FVS) and the Institute of Animal Production (IAP), both of the University of Khartoum, are also engaged in livestock research.

The Agricultural Research Council of the National Council for Research (NCR) assists with organization and financing of multi-disciplinary teams to focus on specific research problems.

Socioeconomic research for agriculture is conducted by the Economic and Social Research Council of the NCR, the Development Studies and Research Center and the Department of Agricultural Economics of the University of Khartoum, the Planning and Agricultural Economics Administration of the Ministry of Agriculture, and the socioeconomic units of the major agricultural schemes.

The agricultural development projects and bilateral and multilateral agricultural companies carry out some adaptive research on field crops -- sesame, sunflower, maize, sorghum, etc. -- which they are growing.

From the institutional analysis (Chapter III, Part III) several conclusions regarding the number of scientists are drawn, including that the ARC is by far the largest single organization involved in agricultural research in Sudan, with a primary focus on crops research. Livestock research at APRA and LVRA of the Ministry of Animal Resources and IAP of the Univeristy of Khartoum is about 3/4 the size of the ARC. The two faculties of agriculture of the Universities of Khartoum and Gezira, involved mainly in crops research, are more than 2/3 the size of the ARC. Taken together, the four organizations involved in livestock research (APRA, IAP, LVRA, FVS) are almost 2/3 size of the four organizations involved mainly in crops research (ARC, FAUK, FASUG).

More than half of the scientists involved in agricultural research in the Sudan hold Ph.D. degrees.

At ARC, one of the two largest disciplines in total manpower is food science. No marked imbalances in manpower strength exists between the traditional crop science disciplines (agronomy, botany/ pathology, breeding, entomology, horticulture, and soil science). But these same disciplines stand in significant contrast to other disciplines in terms of the balance between Ph.D.s and M.Sc.s. All of them have significantly more Ph.D.s, while economics, engineering, fisheries, forestry, and wildlife have more M.Sc.s. One conclusion which can be drawn is that research managers will probably soon wish to consider the desirability of bringing new B.Sc.s into the traditional disciplines, while at the same time giving priority in Ph.D. training to non-traditional disciplines (see Fig. 4, Part III, Chapter III).

Attention to cotton research continues to dominate Sudanese agricultural research. There are no marked imbalances between other commodities, except that oil crops receive somewhat less attention than that might have been expected. As mentioned above, attention to the more traditional commodoties is greater than fisheries, forestry, and wildlife in terms of the balance between Ph.D.s and M.Sc.s.

Expenditure on cotton research has been at the top of the table each year since 1960. Expenditure on wheat and oil crops research has risen quite sharply, while expenditure on horticultural research, faba bean not included, has remained quite low.

Regarding scientists involved in livestock research in the four research institutions -- APRA, LVRA, IAP, FVS -- the most striking conclusion to be drawn from the available data is the manpower dominance of veterinary science over animal production. Approximately 3/4 of the total scientists involved in livestock research are in the two organizations concerned with veterinary science (LVRA and FVS). In terms of number of doctorates, the ratio of veterinary science doctorates in LVRA and FVS to doctorates in APRA and IAP is almost 5:1.

C. Agricultural Research Policy Formulation

To achieve production targets, as proposed in the background document of this study (Chapter III, Part I), the Sudan will need to strengthen its agricultural research capabilities in the areas of policy, organization, and management. Particular attention will need to be given to ensuring that research policies are adequately oriented toward agricultural sector objectives and overall development and society goals.

In general, program priorities are established in at least four levels of decision making:

1. at the cabinet/parliament level, where national development goals are decided;

2. at the level of the ministries concerned, where agricultural sector objectives are spelled out;

3. at the national research system level, where agricultural research programs are built;

4. at the level of implementing research institutions, which decide on their respective research activities.

The process ideally repeats itself with one level feeding information to the other sequentially and in both directions until a final decision is reached. However, basically there is a dominant top-down flow from national authorities to the research system in terms of national policies and directions; and a strong bottom-up flow from the implementary cadres to the policy makers in terms of which realistic and feasible activities can contribute towards these national goals.

The national goals are normally spelled out in the development plans and annual government budget documents. Since these goals are invariably broad, noble, and ambitious, they have not been constraints in program priority setting. Similarly, the agricultural sector objectives derived from national development plans are sufficiently broad to accomodate practically every activity proposed by the research community. Thus, the research community needs more clear, directive statements in order to plan more accurately. More important, the research community organizes and builds its research agenda not on the basis of development goals but along commodities, disciplines, production factors, natural resources, and agro-ecological zones. There is, therefore, a need for a set of statements which form the bridge between development goals and the research agenda to establish very clearly the connection between the two. This involves the need for defining priority setting in agricultural research at the national level.

The priority setting, which has meant adding new research programs to the annual wish list, should be replaced by required evaluating and rank ordering research programs, eliminating some and adding others. This calls for institutional mechanisms at the national level to set research priorities and allocate resources to these priorities. A centralized authority for such a comprehensive research policy to prioritize research at the national level would be necessary.

The centralized authority functions could be to develop clear statements of agricultural research objectives, to set broad research priorities and to rationalize research resource allocations, to ensure consistency of research with the agricultural sector objectives and the national development and society goals. This centralized authority should view policy objectives through a set of transformation functions to ensure this consistency and to ensure that changes in agricultural sector objectives are sequentially transmitted to agricultural research objectives. It also must not concentrate on the supply side (top-down) to the neglect of the demand side (bottom-up). It should operate within the general policy frame to develop articulated agricultural development and agricultural research policies. This will prevent frequent policy revisions, modifications, and reversals. It will facilitate the ease and appropriateness of policy revisions and modifications.

Additional functions of the centralized authority would be to approve national research program and to secure effective coordination and implementation of the multidisciplinary research required for solving the priority problems.

D. Agricultural Research Organization: A Proposed Sudan Agricultural Research Council (SARC)

Agricultural research in the Sudan has already reached a high level of development and organization. It is conducted by several ministries, various departments, and corporations (Chapter III, Part III). The present situation calls for further improvement, in spite of efforts made since the creation of the Agricultural Research Corporation (ARC) and its council (Management Board) within the Ministry of Agriculture, and the establishment of the National Council for Research (NCR) and its specialized councils.

The ARC carries out almost all of the applied agricultural research in the fields of crops, food, fisheries and marine biology, forestry, range and pastures, and game and wildlife.

Animal production and health research is the responsibility of the Animal Production Research Administration (APRA) and the Laboratory and Veterinary Research Administration of the Ministry of Animal Resources, respectively.

The ARC organizes annual agricultural meetings and research symposia on specialized research topics, attended by research specialists and representatives of production bodies, and maintains liaison with committees and councils of the NCR and universities. These arrangements, however, do not necessarily lead to a comprehensive national research program as required to meet development targets, as discussed earlier.

To achieve agricultural development objectives and development and society goals, Sudan will have to strengthen and reorganize its present agricultural research institutional framework. Particular emphasis will have to be placed on measures which will ensure effective research priority setting and allocation of resources, better coordination and implementation of multidisciplinary research activities to address priority areas in agricultural development plans. Policy issues could be achieved by improving organization and management of agricultural research. This calls for institutional mechanisms at national level. A centralized authority for such a comprehensive plan to prioritize research at the national level could be established in the form of a council. A proposed name for this council could be the Sudan Agricultural Research Council (SARC). This council would be responsible to the ministries concerned with agricultural, livestock, forestry, and natural resources development.

There is need to strengthen the policy, planning, and coordinating functions of the NCR, and the proposed SARC aims at achieving better planning and coordination, in all sectors of science and technology and in agricultural sciences.

SARC could combine functions and responsibilities in research policy formulation and research coordination at the national level of the present ARC Council, the Agricultural Research Council of the NCR, the APRA, and LVRA.

The membership of SARC would include representatives at decision-making levels of various parties interested in agricultural research and development, such as: Ministries of Agriculture, Animal Resources, Finance and Economic Planning, Industry and Irrigation; production schemes; farmers' organizations; bilateral and government development projects and companies; research institutions -- ARC, APRA, LVRA, NCR; universities; extension; seed multiplications units.

The major functions of the proposed SARC would be:

- to clearly define national agricultural research policy by developing clear statements of agricultural research objectives, setting broad research priorities, and rationalizing research resource allocation;

- to ensure consistency of agricultural research objectives with the agricultural sector objectives and the national development and society goals;

- to participate in the development of articulated agricultural development policy;

- to approve national research programs;

- to secure maximum coordination of technical, economic, and social research in various fields of agriculture;

- to advise on national priorities for postgraduate training in agricultural sciences;

- to promote bilateral and international cooperative programs and maintain contacts with the international scientific community in the fields of agricultural research.

A technical secretariat could be formed to coordinate implementation of SARC policies and decisions.

E. Agricultural Research Programs

A national agricultural research system is concerned with determining a research program, implementing it, and communicating findings to those who need them. Resources (human, physical, and financial), information, know-how, and management and leadership are needed to carry out all these activities in an appropriate organization and structure.

E.1 Determining the Research Program

The planning and programming of agricultural research is an ongoing and goal-oriented process involving rational decision making and optimizing means and use of resources. Determining the research program is associated with decisions over time at national, institutional, operational, and researcher levels. While decisions are made independently at various levels, the levels are connected by the flow of information downward and upward through the system.

a) Broad priority setting and resource allocation at the national level

The initial stage in program formulation is priority setting for the research enterprise with respect to commodities, production factors, agro-ecological zones, administrative regions, natural resources, etc.

The research system is to address agricultural problems to the extent that research can contribute to their solution and to the extent that resources are available. Thus, the research system must concentrate available resources on the most critical national problems.

Priority setting forms the basis for determining program content, for operational planning, and for resource allocation. Priorities will also be the foundation for updating the long-term plan and planning annual allocation and budget requests.

The main criteria for setting priorities and allocating resources could be:

- consistency with the objectives and goals of the agricultural development plan;

- need for research as expressed by scientists and user groups;

- potential benefits expected from achieving the stated objectives;

- research capabilities and capacity of the resources to carry out adaptive, adaptive plus applied, or adaptive plus applied plus basic research;

- costs of conducting the research;

- amount and kind of research effort conducted by internal and external researchers.

Several factors may constrain resource allocation and kinds of research that the research system conducts and limit the flexibility in resource use. The following factors, which include major constraints, must be considered:

- Availability of scientific expertise. Successful research depends upon the training and experience of individual scientists and upon the teamwork that evolves within and among research units. For both individuals and groups, many years are required to reach peak productivity. To help ensure the availability of scientific expertise, guidance on postgraduate and other training needs for scientists and others should be provided.

- Limitation of geography, climate, and soil. For valid results, field research must be conducted at problem sites and over extended periods of time.

- Nature of the problem. Agricultural research requires suitable physical resources; some research requires costly facilities and equipment that are problem-specific.

- Sequential nature of research. Often one phase of research must be completed before the next phase can be started.

- Continuous adaptation of biological systems. Examples are the resistance of crop pests to chemical control and the genetic improvement of crops that may introduce new vulnerabilities. Priorities must be revised to meet new problems as they arise.

Scientific criteria for setting priorities must be balanced with government policies and with the needs of development agencies and other users of research. It is the task of management to achieve such a balance so that the system may provide its scientists with long-term stability and the firm commitments that are needed for creative research.

From the above, it is clear that a considerable amount of information from a range of sources must be assembled and processed to provide evidence relating to scientific, economic and social criteria used in assessing priorities at the national level. This must be done by a technical staff group, and the outcome information placed before the proposed SARC with the authority to reach decisions on research priorities and allocation of resources. The SARC can produce as an output quantified priorities on research with respect to commodities, natural resources, production factors, agro-ecological zones, etc., reflecting the comparative advantages of agricultural research to create opportunities for national development in different sectors.

SARC should also carry the final responsibility for advising the Government in the national agricultural research strategy which involves a sense of how to evolve from a present situation to a desirable future situation, responding to likely trends with planned changes in the size and form of the research service.

b) Long-term program planning

Once program priorities, resource allocation and strategic planning at the macro level are defined, it is at least as important to identify long-term priorities for research activities at national, institute, and program levels. First the objectives of a research program must be clearly stated. Then, alternative approaches to achieving the objectives are considered. Finally, from among all the possible activities, the most cost effective and most likely to achieve the desired objectives are selected.

The long-term plan describes the kinds of research identified by the system scientists as necessary to meet the short- and long-term needs of agriculture and presents the minimum number of research approaches needed to meet the goals and objectives of the national and institutional program plans. The research approaches are based on current scientific knowledge and will change as knowledge advances or as the research needs of agriculture change.

The first step in the program planning process should be to establish the goals and long-term research objectives. These are already decided in the priority-setting process by SARC. A coordinator for each objective should be assigned.

The second step is to draft a set of proposed courses for action or research approaches to achieve the objectives. This step could be implemented at the national level by assigning experienced national task forces, or at the institute level by the program committees.

In third step, each approach is to be assigned to a selected scientist for further development and identification of research approach elements. Those scientists who represent the whole spectrum of research at the national level or in the institute then - in turn - enlist the help of many other scientists to ensure full consideration of commodities, disciplines, and problem areas. During a period of about two months, the scientists could develop written material that defines the scope and contents of the approaches. The coordinator of each objective should assist in organizing the written material. Scientists organize each research approach element into one or more project areas. The scientists provide the following information for each approach element and project area:

- the nature of the problem to be solved and its scientific and agricultural importance;

- state-of-the-art or current research status and critical research needs or events for further progress;

- the kinds of results expected (reports, germ plasm, models, etc.) and length of time needed to produce these results;

- potential benefits and impacts that can be expected if the research is successful;

- probability of successful achievements; and

- relative priority of the research.

That information is used to help develop and define the final set of research approaches, approach elements, and project areas. Thus, duplication is eliminated, and only the approaches that are essential to achieving the objectives are selected. Objective coordinators and national task forces or institute program committees then develop brief narrative summaries for the final research approaches and approach elements.

The final research approaches are those to be selected from the originally proposed and described research areas that offer important opportunities for increasing the productivity of agriculture. A catalog of project areas should be prepared for use in resource projection. The program committees should develop the resource projection needed for use in the long-term plan which, in turn, will guide the preparation of short-term and annual work plans. The long-term and short-term plans will be revised, as appropriate, to reflect the latest scientific findings and most urgent needs of agriculture.

c) Short-term and annual research programs

The short-term (2 - 5 years) and annual research programs are determined on the basis of current staff, facilities, and financial resources.

The short-term programs are usually made up of a number of sub-programs or projects, each with a number of experiments that may need to be carried out through several years before reviewing. In reality, the budgets in most countries are formulated on an annual basis, and funds are allocated on a fluctuating availability. Therefore, the annual research program is the firmest statement possible of the aggregate of experiments and studies to be carried out during the year with the available resources.

Annual research program planning should be institutionalized to confirm quality and relevance of research through a cyclic procedure involving management and researchers to ensure consistency with institute and national research long-term priority, quality, and relevance of research. In this context, the annual programming cycle similar to the one shown in the accompanying diagram, which is proposed to improve research programming for establishing, evaluating periodically, and adjusting research programs, projects and operations. This cycle is an ongoing process which must form part of the overall calendar of national budgetary procedures.

In the accompanying diagram, interactions among the various chronological stages and decision making at the political, institutional and professional levels are indicated.

In small research institutions, experiment and study proposals could be studied and approved by the director of the research institute and a small group of the most senior staff. But in most institutions it is vital to have decentralized review groups, Program Committees, to carry out the careful review required and report to the management of the institute through an Office of Projects which documents the outcome of the evaluation by program committees. This process will ensure that research workers who are deeply informed on technical details have proposed good-quality experiments and studies. However, assessing the relevance of proposed experiments and studies is often more difficult than checking on quality when the objectives of research are to solve production problems rather than to make detailed progress within disciplines. It is, therefore, highly desirable for each program committee to have multidisciplinary membership that reflects the many facets of practical productivity problems in a commodity, including the socioeconomic limitations of farming systems. It is desirable that representatives of concerned groups such as production schemes, development projects, farmers, extension, seed administration, etc. should be invited to participate in program committee meetings.

In order to be reviewed adequately, a project proposal must be well documented by the Office of Projects to include, for instance:

- a brief outline of the situation, including client conditions;
- why research is needed and the precise objectives of the research, the expected outputs and the relevance of potential results to clients, the research institution, and the country;
- the plan of work, defining responsibilities of the project staff;
- cost estimates, including research and support staff time, facilities, and recurrent funding required, and the estimated duration of the project;

- a reporting schedule on progress activities and the conclusion of project.

This project documentation is not only valuable in reviewing presen proposals, it is also the basis for any subsequent planning of staff ti and monitoring and evaluation of progress.

Thus, the office of projects plays a central and decisive part in th progress of programming by driving the cycle as a whole, performing the standardized preparation of information, and acting as a secretariate fo program committees.

Within the present public administration, legal and financial procedures and rules, the annual programming cycle could be approximately as described in Diagram 1.

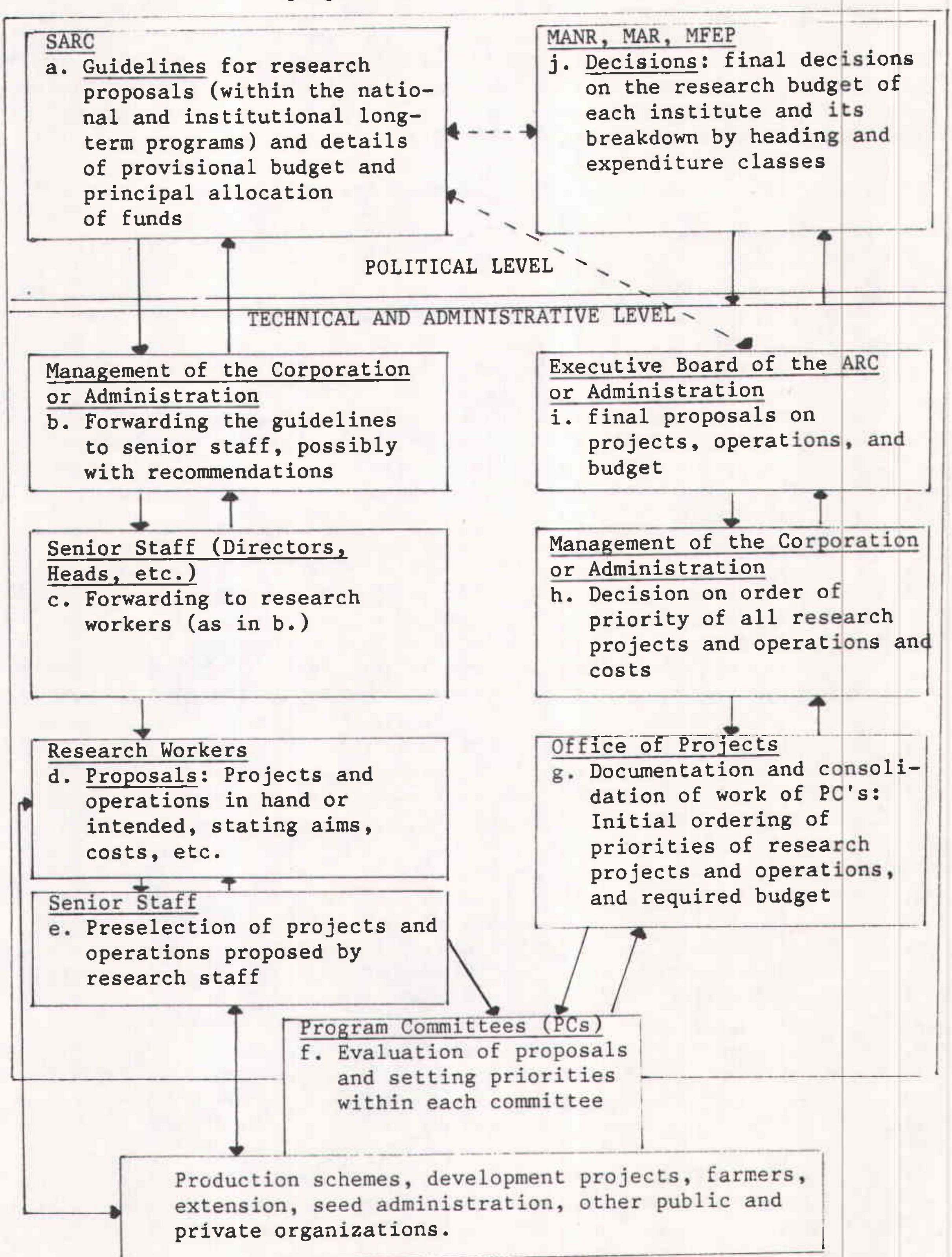
The annual programming cycle cannot be allowed to call into question each year all the research projects currently under implementation. Field research projects should normally be approved for a minimum period of three years, as it seems unrealistic to obtain significant and reliable results from this type of works in a shorter period of time. It is also inappropriate to make frequent changes or amendments to projects in hand or anticipate a too-distant future. Therefore, the annual evaluation of work of the projects will keep track of the statusof activities, monitor progress, and evaluate new topics submitted by the research staff.

In the short-term and annual research programs, budgeting by researchers for annual activities can be more precise than for long-term program plans. Operations can be costed and operational budgets and staff time requirements associated with each component proposal can also be estimated. Individual returns aggregated to full program budgets for section, station, and institution can constitute a powerful management tool at each level. If the documentation has been completed properly, the office of projects will provide information to the director, program leader or head of department on what experiments and studies each member of the staff is involved in and to what extent and what the total resources needed are likely to be.

The program budgeting system will help managers to assess allocation of funds and research staff time to different disciplines, commodities, research stations, regions, etc. It also helps maintain a realistic ratio of operating costs to salary; permits making a case for realistic funding; helps guide the effective use of funds by specific objectives; and provides a base for monitoring physical and financial progress.

The program budgeting system is a much more powerful tool if the information recorded is simply coded and the process computerized.

Diagram 1. Principles of the annual programming cycle.
A proposal for ARC, APRA, and LVRA.



E.2 Implementing Research Programs

Research programs must be determined in relation to the human resources likely to be available and to the national funding of research support for agricultural development. Once research programs have been determined on the basis of research priorities, implementing research programs involves organization of manpower to carry out the research activities, and provision of funds and facilities to enable them to function efficiently and produce and communicate research results effectively.

a) Investment in research and allocation of resources

The three major research institutions -- ARC, APRA and LVRA -- receive Government funds in three chapters (categories). These are chapter I for salaries and salary-related expenditures, chapter II for operational costs (overhead costs and direct research costs), and chapter III for institutional development (capital investment). The budget allocated in 1986/87 to those three institutions is shown in Table 1.

Table 1. Government budget for ARC, APRA, and LVRA (1986/87)
(Million SP *)

	Salaries	Operation	Capital	Total
ARC	11.958	1.000	1.000	13.958
APRA	0.871	0.357	0.615	1.843
LVRA	0.980	0.600	0.120	1.700
Total	13.809	1.957	1.735	17.501

* SP = Sudanese Pounds

In addition to the block fund from the Government, ARC received financial support of 11 million SP to the operation category from various sources within and outside the Sudan.

The total Government investment for three institutions is 17.501 million SP for 1986/87 (rate of exchange for one US$ is 2.5 SP for 1986/87, and 4.5 SP for 1987/88). This is approximately 0.83% of the AGDP in 1986/87. When the external financial resources are added to the total Government expenditure in agricultural research for the three institutions, the investment in agricultural research will be approximately 1.35% of AGDP. Compared with many developing countries, this represents a better than average level of investment in agricultural research, and it is not far from the norm of national investment in agricultural research of 1-2% of the AGDP. Of course, this figure (1.35%) will be higher if we add research expenditure in the universities of Sudan and in other minor research institutions.

Allocation by commodity: As mentioned earlier, most of the research efforts are in the irrigated sector, and cotton continues to dominate Sudanese agricultural research. However, other commodities are now receiving greater attention through external support from within and outside the country. Most important among support resources are funds from Sudanese production schemes, sugar and cotton companies. These funds are allocated to research operations in the irrigated sector -- cotton, sugarcane, groundnut, sorghum and vegetables -- and funds from donors covering research operations for wheat, fababeans, sorghum, groundnuts, food technology, and others.

Among donors financing research projects in Sudan (Chapter III, Part II, Table 12), the following projects are the most important in the allocation to commodity research.

The Western Sudan Agricultural Research Project (WSARP) is jointly funded by USAID and the World Bank to develop the rainfed sector by strenghtening the research base on sorghum, millet, rangeland, groundnut and farming systems.

The Agricultural Research, Extension and Training Project (ARETP) is funded by the World Bank and the Government of Sudan to increase crop production in the irrigated agricultural sector through strengthening the technical capacity and efficiency of agricultural research and extension. The project over a 6-year period would strengthen the technological base required for higher production, reform subsector extension system, and upgrade the skills of field personnel.

The ARC/ICARDA joint Nile Valley Project is funded by IFAD to improve fababean production and the ARC/ICARDA joint project on wheat funded by OPEC to verify and adapt improved wheat technologies; and many other projects.

This approach of external-driven funded research projects has advantages as well as constraints. It ensures financial and technical support and helps scientists to implement their research operations. Problems associated with this approach are the tendency for financing research projects of lower ranks in the agricultural development and research at the same time when high-rank projects are not receiving enough financial support, termination of financial support to externally funded ongoing research projects when the objectives have not been achieved, and frustration of scientists who are not receiving external financial support for their research operations. Establishing a national research policy will overcome most of these constraints.

Ratio of salaries to operational funds: In many national agricultural research systems, the salary costs reach between 60 to 70% of the total budget, sometimes even 80% or more in exceptional cases; while direct operational costs (including operational and experimental inputs) vary between 15 to 35% of the total budget. The remaining 5 to 15% is for overhead costs. These ratios are only efficient if the budget level is high enough to pay good salaries to the research staff (50 to 60% of the total budget) and still provide enough operational funds to use equipment efficiently, to conduct reliable experiments, and to ensure the required mobility of the staff.

Salaries of scientists at the ARC have been comparable with those of scientists at universities in Sudan, and they are above salary scale at the civil service. In addition to salary, housing or housing allowances and other emoluments are provided to ARC staff. However, the recent increase of salaries to university scientists calls for a degree of parity in ARC.

One of the most important constraints ARC has faced during the last decade is the lack of adequate operational and capital funds (about 14% of the total ARC budget). As mentioned earlier, ARC has been forced to look for external funding to carry out its research activities. In 1986/87, ARC received financial support for operation and capital items of the ARC budget. The ratio of the salary item to other items of the budget has reached to about 1:1. This ratio for APRA and LVRA is also about 1:1 (Table 1).

The annual contribution from external sources to research expenditure of ARC has increased from 4.6% (average of 1975-1977) to 46.7% in 1978 to 67.5% (average of 1979 to 1985) of total research expenditure (operating costs and capital). The increase during the period 1979 to 1985 is attributed to the contribution of WASRP which began operating in 1979.

Funding for university research: The bulk of research conducted so far by universities in the fields of agriculture and veterinary science has been linked to the postgraduate studies program in partial fullfillment of the M.Sc. degree. In addition, the academic staff have their own research activities and projects which are chosen on a personal interest basis.

The funding sources of the university's research are university budgets and external sources from inside and outside the country. The total allocation in 1986/87 for research operational funds at the FAUK, FASUG, FVS and IAP was about one million Sudanese pounds.

The research capacity of the universities with 166 Ph.D. scholars should be drawn into the national agricultural research programs by allocation of more reliable core funds for research to facilitate collaborative research work with national research institutions on high-priority problems.

Flow of funds: The three research institutions, ARC, APRA and LVRA, have no problem in receiving the approved budgets from Government; but APRA and LVRA indicated a problem of delays in receiving approved funds from national sources. The three institutions face inadequate inflation adjustment in the annual budget.

The revenue from institute production is retained by ARC, while in the case of APRA and LVRA this revenue is retained by the Treasury and, therefore, it is a problem for the latter two institutions.

b) Manpower for agricultural research

The strength of the national agricultural research system depends on the cadre of experienced research personnel of appropriate size, disciplinary mix, and education level. The research system must be able to effectively recruit researchers and technicians, offer them good career prospects and opportunities for further training, and provide them with incentives for achievement as well as a long-term commitment to service.

Distribution and training: The Sudan has a relatively large, well-trained cadre of agricultural scientists. The distribution of research and support staff in each research institution according to level of qualification of scientists and assistant scientists, Ph.D., M.Sc., and B.Sc. is shown in Table 2.

ARC scientific ranking, for example, consists of five grades. These are assistant scientist (B.Sc. graduate), scientist (M.Sc. or Ph.D. graduate), senior scientist (M.Sc. or Ph.D. graduate), assistant professor (M.Sc. or Ph.D. graduate) and research professor (M.Sc. or Ph.D. graduate). Thus, the distribution of scientific staff at ARC is: 80 assistant scientists, 94 scientists, 44 senior scientist, 23 assistant professors, and 30 professors. Of those that have Ph.D.s, about 90% have attained their degrees from U.S.A. and Great Britain. About 29% of Ph.D. and M.Sc. scientists are at the Gezira Research Station and ARC Headquarters at Wad Medani, 15% at the Food Research Center in Khartoum, and 15% at the Forestry, Fisheries, and Wildlife Research Centers. Of the remaining scientists, about 40% are distributed in other regional and provincial stations dealing with crop research. However, these are the less-experienced scientists, and they receive little supervision.

More than 2/3 of APRA scientists are at Headquarters and Kuku Laboratories in Khartoum, while the remaining scientists are distributed thinly among the three cattle stations at Atbara, Umbenien, and Ghazala Gawazat; one sheep research station at Huda; and one dairy research station at Shukaba.

About 80% of the M.Sc. and Ph.D. scientists of LVRA are at the headquarters in Khartoum. The remaining scientists are distributed among regional stations at Nyala, El Obeid, Sennar, and Kassala.

The ratios of professors to associate professors (readers) to assistant professors (senior lecturers and lecturers) are 1:1:6.8 for FAUK; 1:6:3:8.6 for FASUG; 1:0.8:1.4 for FVS; and 1:1.6:4.1 is the average for these faculties.

The percentage distributions of qualifications and years of experience among scientists of ARC, APRA, LVRA, FVS, FAUK, and FASUG are shown in Table 3.

Conditions of service: Salaries of researchers at ARC have been comparable with those of the academic staff of universities, and they are above salary scales in the civil service. Housing and housing allowances are provided to ARC staff. Recently, salaries of academic staff at the universities have been increased to a level of 100% above those of the researchers of equal experience at the ARC.

The income profile indicates that those holding B.Sc. degree earn less income, and either terminate their employment with the organization or proceed with higher education. Those researchers holding the M.Sc. degree tend to have more longevity with the organization and ultimately earn slightly less than those researchers holding the Ph.D. (Annex: Part IV).

Table 2: Sudan Agricultural Research Human Resources - 1987

	PhD	MSc	BSc	Post Graduate	Total Scientists	Technical Support	Administrative Support	Other	Total
Agricultural Research Corporation	125	66	49	31	271	548	302	3109	4230
College of Agricultural Studies Khartoum Polytechnic	14	30	8	7	59	36	61	323	479
Abu Haraz College of Agriculture	1	16	6	3	26	13	11	110	160
Abu Naama College of Agriculture	3	18	-	3	24	5	1	150	180
Economic and Social Research Council	7	8	1	5	21	1	7	-	29
Agricultural Research Council	4	2	4	-	10	-	6	-	16
Animal Production Research Administration	11	18	17	4	50	48	27	457	582
Institute of Animal Production	11	2	2	6	21	10	8	27	66
Faculty of Veterinary Science	47	7	17	-	71	78	19	120	288
Veterinary Research Administration	45	39	43	24	151	165	18	192	526
Faculty of Agriculture University of Khartoum	60	1	34	-	95	42	28	147	312
Department of Agricultural Engineering, University of Khartoum	1	1	3	4	9	1	1	-	11
Faculty of Agriculture University of Gezira	48	7	5	7	67	27	8	170	272
Total	377	215	189	94	875*	974	497	4805	7151

* There are also 8 expatriate scientists

Table 3. Percentage distributions of qualifications and years of experience among scientists of major research institutions and Faculties of Agriculture and Veterinary

Institution	Qualifications			Research Experience (years)				
	Ph.D.	M.Sc.	B.Sc.	0-2	3-5	6-10	11-15	+ 15
ARC	52.1	27.5	20.4	14.5	8.5	12.5	19.5	45.0
APRA	23.9	39.1	37.0	32.6	17.4	21.7	15.2	13.0
LVRA	35.4	30.7	33.9	0.0	11.0	33.1	23.6	32.3
FVS	66.2	9.9	23.9	9.5	23.5	7.4	27.9	31.7
FAUK	63.2	1.0	35.8	18.0	16.8	33.7	20.0	11.5
FASUG*	80.0	11.7	8.3	n.a.	n.a.	n.a.	n.a.	n.a.

* operating since 1978.

The ratio of technical support staff to scientists is appropriate for ARC (2.3:1). In other institutions, it is approximately 1:1 in APRA, LVRA and FVS, and 0.4:1 in FAUK and FASUG. It is obvious that this ratio is low in the universities because most research is carried out by MSc students.

The percentage distributions of qualifications and years of experience among technical support staff of ARC and APRA are shown in Table 4.

Its is obvious from Tables 3 and 4 that research and technical support staff of ARC of more than 15 years experience consist of about half to 2/3, respectively, of the total technical staff.

Table 4. Percentage distributions of qualifications and years of experience among technical support staff of ARC and APRA.

Institution	Qualifications		Research experience (years)				
	Diploma	Non-diploma	0-2	3-5	6-10	11-15	+ 15
ARC	43.7	56.3	8.5	8.2	12.6	8.4	62.3
APRA	56.2	43.8	4.2	33.3	35.4	-	27.1

The percentage annual growth rates of research and technical support staff of ARC, APRA and LVRA during two periods, 1975-80 and 1980-87, are shown in Table 5.

Table 5. Annual growth rates (%) of research and technical support staff of ARC, APRA, and LVRA, 1975-80 and 1980-87.

Instit.	1975 - 1980					1980 - 1987				
	Ph.D.	M.Sc.	B.Sc.	All	Techn.	Ph.D.	M.Sc.	B.Sc.	All	Techn.
ARC	19.2	37.6	2.7	20.0	5.2	1.7	0.0	19.3	3.0	1.6
APRA	35.0	2.8	-7.8	1.1	4.4	0.0	1.8	7.8	3.0	1.3
LVRA	11.8	15.0	4.2	9.3	16.6	9.5	1.6	-1.7	2.2	8.3
Average	22.0	18.5	-0.3	10.1	8.7	3.7	1.1	8.5	2.7	3.7

In general, there has been a sharp reduction in the annual growth rates of research and technical staff in the eighties. Ph.D. recruitment was very high in the first period (1975-80), 22% annual growth rate, and decreased to 3.7% in the second period (1980-87); while B.Sc. recruitment has increased sharply in the second period for ARC and APRA.

Research institutions in the Sudan are facing difficulties with regard to maintaining an adequate supply of scientists. Scientists tend to leave the research institutions, either by resigning or on secondment, to other better-paid institutions in the neighboring countries of the Arabian Peninsula or to international and regional organizations. This tendency has recently been increased due to the high rise in cost of living. The high difference in scientists' salaries is difficult to eliminate in the foreseeable future.

In attempting to counteract excessive rates of staff turnover and to maintain high morale among research staff, research institutions should develop good incentive structures. Thus, career plans for Sudanese research staff are needed to predict staff problems and encounter them over the years to come.

Manpower plans: Manpower planning is concerned with the assessment and provision of the types and amounts of skills required for the attainment of predetermined tasks over a specified time period in a cost-effective manner. This planning process is concerned with the required and available human resources.

Once research program decisions are made on a long-term basis, each research institution can project staff needs and plan for staff degrees and in-service training.

Regarding the short-term and annual work programs, only the research institution is in a position to make a realistic assessment of current staff qualifications, allocation of staff to activities, and the potential for short-term growth through recruitment and those obtaining their postgraduate degrees from the Sudan and abroad.

Efficient human resource planning, long-term and short-term, must have comprehensive and up-to-date information on all key aspects of the utilization of human resources. This has been dealt with earlier in the program determination.

When requested to describe the nature of training that was required to achieve career objectives, most of the requests were for PhD training; and most of the requests were for out-of-country long-term training (Chapter III, Part IV).

With regard to staff development, each research institution should respond to the real needs of its research program. Considerable emphasis should be placed on in-service and formal training for researchers and other technical support staff inside and outside the Sudan. Universities already have M.Sc. training programs. For example, 55 M.Sc. theses were produced at FASUG during 1980-1987, of which 27 were in plant protection, 23 in plant crops, 2 in forestry and 1 each in soils, agricultural economics, and livestock. The M.Sc. programs, however, should be strenghtened and thesis research which is required to fulfill the M.Sc. degree should be related to the problems of agriculture in the Sudan.

Planning and development of human resources should be organized at national and institutional levels to deal with reviewing future research program needs, organizing in-service training, including research management training, assisting local educational institutions to meet research institution staff needs, and seeking fellowships for non-degree and postgraduate degrees in the country and abroad in relation to the needs of long-term research programs.

c) Facilities

The availability and maintenance of physical resources to conduct laboratory and field experiments and studies is a sine qua non for agricultural research. Development of good physical resources is an extremely complex process. The consistency and quality of physical resources has a great influence on the quality of research output.

Field and laboratory: Availability and condition of research physical resources in the Sudan vary from one institution to another. The results of the questionnaires for physical resources, mainly equipment and library conditions, are summarized in Table 6.

Table 6. Infrastructure conditions of major research and university institutions.

Institution	No. of stations	Total Land (ha)	Laboratory equipment availibilty & condition	Maintenance of equipment	Library
ARC	19	3947	very poor	absent	very poor
APRA	5	600	poor	absent	very poor
LVRA	5	309	good	poor	poor
FAUK	-	-	good	poor	good
FASUG	1	500	good	poor	good
FVS	-	-	good	very poor	poor

It shows that laboratory equipment availability and condition are poor to very poor in ARC and APRA; and good in the Faculties of Agriculture and Veterinary, and LVRA. LVRA is engaged in vaccine production and veterinary research. Good laboratory equipment is a prerequisite for producing valid vaccines. However, maintenance of equipment is poor to absent in all institutions.

Realizing the importance of the physical resources problem, ARC, with help from donors, implemented a program of rehabilitation of research stations. Examples of this program are: the WSARP, in which three research stations in Western Sudan have been rehabilitated; ARETP project is involved in the rehabilitation of six research stations in the irrigated subsector; rehabilitation projects of Northern region financed by IFAD will establish a new research station at Donkola and rehabilitate Hudeiba Research Station; and rehabilitation of Gezira Research Station and Kenana Research Station, sponsored and financed by AFESD.

Other joint research projects have physical resource development components, such as the FAO/Netherlands Government Project on IPM; IAEA Project to strengthen pesticide and soil laboratories at ARC; Fababean Nile Valley Project sponsored by IFAD and ICARDA, which also provides field and laboratory equipment concerning fababean research; a project financed by OPEC provides field and laboratory equipment for wheat research; a potato farming development project, sponsored by CIDA and CIP, provides equipment for potato research.

Library and documentation: Table 6 shows that libraries are in poor to very poor condition in the research institutions -- ARC, APRA, and LVRA -- and in FASUG and FVS. The FAUK library is in good condition.

The Sudan is participating in AGRIS/CARIS through a liaison at ARC. There are attempts to develop a documentation center for agricultural research at ARC.

Facility planning: In making decisions about the type and number of research stations, support services, and equipment, a fundamental consideration is sustainability, over time, from national resources.

Buildings, land, equipment, and other components of station physical resources will deteriorate and eventually become non-functional without strategies for developing and use of buildings and land, maintenance and repairs, developing equipment, supplies and purchasing, developing physical resources personnel, and centralizing some services at national, institutional, and research station levels. These strategies will be considered while developing long-term plans for physical resources at institute and national levels.

At the national level, the proposed SARC would take the responsibility for setting policies for planning site development, maintenance and repair, supplies and purchasing, and physical resources personnel.

Sharing and centralizing some facilities, where possible, should be adopted to maximize the use of physical resources. To do so, the existing physical resources should be inventoried to promote inter-institutional, inter-departmental and inter-station use of such resources, make accessible and facilitate the use of sophisticated and expensive equipment and study the feasibility of centralizing some facilities and services at national and institute levels.

Central facilities and services at the national level could include an information and documentation center, including a central library, publication and information, computer and statistics, and conference facilities; maintenance and repair of scientific instruments and sophisticated equipment; and central laboratories needed for research stations; and public concerns, such as land conservation and resources, soil testing and classification, pesticide regulations and testing, pest and disease surveys and identification, museum collections, seed bank, meteorology services, electron microscope, hydrology and water supply, and topography. At the station level, central facilities and services could include central stores; supplies and purchasing; maintenance and repair; farm operations; routine analytical laboratories; library; communication services; and expensive and sophisticated equipment.

Regarding site development and use at the station level, a station site planning and development committee should be formed. Field scientists should be represented in this committee to ensure that field research, the primary purpose of the station, is carried out properly.

In developing a strategy for maintenance and repair, steps to be considered are to estimate the capacity of the institute's services to meet maintenance needs, to estimate the current and future needs of supplies of spare parts and special equipment (for the maintenance and repair services), and to develop physical resource inventories.

A central services unit in each of the research institute should be established to support all the needs for maintenance and repair of the farm and laboratory equipment of each research institute. It is perhaps desirable to establish a national services unit for maintenance and repair of expensive scientific instruments. Maintenance should be programmed into a long-term plan, with financial provisions as a high priority. This plan should be based on information provided by operators and scientists.

Equipment is usually the largest capital investment in a research institute, excluding building and land. This includes laboratory, field, office, utility, and workshop equipment; all of which must be correctly selected, properly used, and adequately maintained in order for research to achieve its objectives. Standardization of equipment within the research institute, wherever possible, will reduce the variety of spare parts, lessen the inventory and minimize the requirements for additional training of the operational and service staff.

Typical problems facing the supply and purchasing system, for instance, are the lack of foreign exchange for libraries to continue subscriptions to scientific journals and supply up-to-date books; import policies and lack of foreign exchange prevent research institutes from importing the required equipment and expandable supplies, e.g. laboratory chemicals and glassware, and the lengthy administrative procedures involved in assuring availability of supplies and materials at the right time at the research institutes.

To ensure availability and quick supply the research institute should have a central supplies and stores unit which stocks a variety of spare parts, expendible items, and even limited stocks of field equipment. To avoid running out of supplies, this unit must maintain an inventory control based on the needs of researchers and support staff. Emergency purchases are thus limited to materials rarely used by the institute.

The presence of many research institutions in agriculture in Sudan, and the rapidly increasing cost of maintaining traditional documentation systems point to a need for considerations of systems based on modern technology. Thus, an agricultural library and documentation system at the national level would be established to assure that information will be provided to researchers in time and serve the whole research community efficiently. This proposed center will also serve as a communication center to take full advantage of data banks and information communications networks that already exist.

A plan for training and development of physical resources personnel should be developed. Farm managers, operators of physical plant services, purchase and supply staff, field and laboratory technicians, and maintenance and repair staff should receive skills development training. Their role in successful research is important. For instance, it must be recognized that skilled farm operators, from farm managers to the general labor level, are as vital a part of the research team as the scientists themselves. It would appear that the best approach would be some on-the-job training, further education, and afterwards advanced on-the-job training if needed. Thus, the research institute could suitably enhance career opportunities for the physical resource operators as well as for other support staff. The training process should be a continuous one in order to ensure availability of qualified physical resources operators.

d) Linkages with the technology transfer system and users

The research system is successful if the knowledge it produces can be translated into improved technologies which farmers are willing and able to adopt. This process depends on effective interaction between the research system -- the technology-generating system -- and extension services, development agencies, and farmers -- the technology-using system.

Reducing the technology transfer gap between the technology generating and using systems involves creating formal institutional mechanisms for linking the two systems for getting research results to farmers to facilitate their adoption of new technology, to give them more production options, and to stimulate agricultural development.

In Sudan there is no unified national extension service. Separate extension programs are conducted by each public agricultural production corporation, by each administrative region, by each agricultural and rural development project, and by each private and multi-lateral agricultural company (Chapter III, Part II, Table II. 13).

First, in the irrigated agricultural production corporations, extension work is implemented by the field inspectorate of each corporation, where inspectors are more experienced, particularly with cotton production, and they are heavily loaded with administrative work and have little time for an effective extension role. Thus, each production corporation has established an extension unit, in addition to its inspectorate service, to improve technology transfer to its farmers.

Second, in the traditional rainfed and irrigated areas, extension operations were until a few years ago the responsiblity of the National Agricultural Extension Administration (NAEA). Since the decision in 1981 to regionalize agricultural services, however, this responsibility has gradually been passed to the Regional Agricultural Extension Unit (RAEU) in each administrative region. Since regionalization, there has been no clear definition of NAEA's role vis-a-vis either production corporations or RAEU. The NAEA role is now largely confined to providing advice and support to these regional extension units. It prepares extension materials for the RAEUs and for the agricultural production corporations, writes radio and television extension programs, runs training courses for regional extensionists as well as occasional courses for farmers, and coordinates an FAO-sponsored program of irrigated fertilizer trials and demonstrations.

Third, the agricultural and rural development projects -- BNIARDA, JMRDP, NMRDP, WSDP, private and multi-lateral companies, and sugar companies, all have their own demonstration trials and develop technology packages for their farming enterprise.

The Agricultural Research, Extension, and Training Project (ARETP), during its life, 1986 to 1992, will upgrade the skills of the field inspectorate and establish programmed extension services (T and V) in agricultural production corporations, and will strengthen NAEA to enable it to provide support to all production corporations of the irrigated sector. ARETP is supporting activities to improve the ARC research linkages with extension in the production corporations.

There is growing realization among ARC staff that the link between ARC and the extension service should be strengthened to improve the effectiveness of ARC in reaching the farmers' needs. This approach calls for joint planning and execution of on-farm adaptive research to ensure links between technology-generating research and farmers' needs. Each research station, therefore, would design its on-farm research along the main concept linking experiment station research with research on farmers' fields. Consequently, each station, with extension, should gather relevant physical, agricultural, and economic information about the area in which it is located, analyze present production systems prevailing in the area to identify production problems, and involve the extension, the farmers, and the concerned development agencies in the design, evaluation,
and decision process regarding new technologies.

Two examples of on-farm adaptive research are worth mentioning. These are the ICARDA/OPEC pilot project for verification and adoption of improved wheat production technology in farmers' fields in the Sudan, and the ICARDA/IFAD Fababean Nile Valley Project. In both projects, trials are conducted at farmer-managed, researcher-managed, and on-farm yield verification levels. This approach should be expanded to other commodities to ensure participation of all parties concerned with technology generation and transfer.

With the exception of cotton, the present production of improved seeds and making them available to the farmers is far below need. The National Seed Administration is inadequately equipped to provide the required improved seed to the farmer. The need for developing a seed policy and program in the Sudan, therefore, is crucial to ensure that technology generation and transfer efforts have achieved their objectives.

F. Summary of Proposals

Agricultural research in Sudan plays a key leadership role in developing and adapting the technology required to meet the needs of agricultural development. It has many strengths and compares favorably with agricultural research systems in many developing countries.

To achieve production targets, as stated in Part 1 of the Annex, the Sudan will need to strengthen its present agricultural research capabilities in planning and implementing system-building strategies in the fields of agricultural research policy, organization, and management.

Agricultural research policy formulation

At the national level, particular attention will need to be given to ensuring that research policies are adequately oriented toward agricultural sector objectives and overall development and society's goals. The required research policies determine how many and what kind of resources are available to the Sudan agricultural research system, how they are allocated, and how research priorities conform to the agricultural sector objectives. A centralized authority to formulate such a comprehensive national research policy would be necessary.

Agricultural research organization: A proposed Sudan Agricultural Research Council (SARC)

In spite of efforts made since the creation of ARC and its Council (Management Board) and the establishment of NCR and its specialized councils(one of them covers agricultural research), the present situation is not satisfactory for setting up a comprehensive national research program as required for meeting development targets.

Research policy issues could be achieved by improving organization and mangement of agricultural research. This calls for institutional mechanisms at the national level to base agricultural research on sound economic considerations. A centralized authority to prioritize research at the national level should be established in the form of a council. A proposed name for this council could be "Sudan Agricultural Research Council (SARC)". This council will be responsible to the ministries concerned with agriculture, livestock, forestry, and national resources development.

This proposed council could combine functions and responsibilities in agricultural research policy formulation and research coordination at the (national) level of the present ARC Council and the Agricultural Research Council of the NCR.

Determining the research program

The planning and programming of agricultural research should be an ongoing process and should be goal oriented. It is associated with decisions, over time, at national, institutional, operational, and researcher levels.

a) Broad priority setting and resource allocation at the national level

At present there is no national forum at which national research priorities can be developed, and coordination between various research institutions is poor.

There is need for a considerable amount of information from a range of sources which must be assembled and processed to provide evidence relating to scientfic, economic and social criteria to be used in assessing research priorities at the national level. This must be done by a technical staff group, and the outcome information placed before SARC, which has the authority to reach decisions on research priorities and allocation of resources. SARC, therefore, can produce as an output, quantified priorities on research with respect to commodities, natural resources, production factors, agro-ecological zones, etc., reflecting the comparative advantages of agricultural research to create opportunities for national development in different agricultural sectors.

b) Long-term program planning

Once program priorities, resource allocation, and strategic planning at the macro level are defined, it is at least as important to identify long-term priorities for research activities at national, institute, and program levels. First the objectives of a research program must be clearly stated. Then, alternative approaches for achieving the objectives are considered. Finally, from among all the possible activities, the most cost effective and most likely to achieve the desired objectives are selected.

The first step in the program planning process is establishing the goals and long-term research objectives. These are already decided in the priority-setting process by SARC. A coordinator for each research objective should be assigned to coordinate the proposed courses for action or research approaches for achieving the objective.

The second step is to draft a set of proposed research approaches at the national level by assigning experienced national task forces, or at the institute level by the program committees.

In the third step, each approach is to be assigned to a selected scientist for further development and identification of research approach elements. Those scientists who represent the whole spectrum of research at the national level or in the institute then - in turn - enlist the help of many other scientists to ensure full consideration of commodities, disciplines, and problem areas. During a period of about two months, the scientists could develop written material that defines element and project contents of the approach. The coordinator of each objective should assist in organizing the written material.

c) Short-term and annual research programs

An annual programming cycle is proposed to confirm quality and reference of research and improve research programming for establishing, evaluating periodically, and adjusting research programs, projects, and operations.

It is proposed that each major research institution, e.g. ARC, APRA, LVRA, should have decentralized review groups and program committees, to carry out the careful review required and report to the management of the institution through an office of projects which documents the outcome of the evaluation by program committees. Program committees should work in collaboration with production schemes, development projects, farmers, extension, seed administration, and other public and private groups.

It is proposed that in each institution, a program budgeting system should be established to help in assessing allocation of funds and research staff time to different disciplines, commodities, research stations, etc., to help maintain a realistic ratio of operating costs to salary, and to provide a base for monitoring physical and financial progress.

Implementing research programs

Once research programs have been determined on the basis of research priorities, implementing research programs involves organization of human resources to carry out the research activities, and provision of funds and facilities to enable them to function effectively and produce and communicate research results effectively.

a) Investment in research and allocation of resources

Establishing a national research policy and developing long-term research programs will help to maintain research priorities and to provide a framework for allocating financial resources from Government and donor sources and using them most effectively.

The ratio of salaries to operational funds should be efficient for paying good salaries to the research staff (50 to 60% of the total research institute budget) and for providing operational funds for using equipment efficiently, for conducting reliable experiments, and for ensuring the required mobility of the staff.

b) Manpower for agricultural research

The research system must be able to effectively recruit researchers and technicians, offer them good career prospects and opportunities for further training, and provide them with incentives for achievement.

To ensure long-term commitment to service and to counteract excessive rates of staff turnover and to maintain high morale among research staff, research institutions in the Sudan must develop good incentive structures, including career plans for research staff to predict staff problems and encounter these problems over the years to come.

Planning and development of human resources should be organized at the national and institutional levels to deal with future research program needs, organizing in-service training, including research management training, and seeking fellowships for non-degree and postgraduate training in the Sudan and abroad.

c) Facilities

Buildings, land, equipment, and other components of research institute physical resources will deteriorate and eventually become non-functional without strategies for development and use of buildings and land, maintenance and repairs, developing equipment, supplies and purchasing, developing physical resource personnel, and centralizing some services at national, institutional, and research station levels.

At the national level, the proposed SARC would take the responsibility for setting policies for planning physical resources. It has been proposed that central facilities and services at the national level could include establishing a national agricultural library and documentation center, including a central library, publication and information, computer and statistics, and conference facilities; and establishing a national or institutional center(s) for maintenance and repair of scientific instruments and sophisticated equipment.

Strategies for site development, maintenance and repair, supplies and purchasing, and training and development of physical resources personnel at national and at institute levels should be developed.

d) Linkages with the technology transfer system and users

The proposed annual programming cycle for each institute ensures participation of farmers, extension, development agencies, etc., in the programming process.

On-farm research along the main concept of linking experiment station research with research on farmers' fields should be expanded to cover all commodities.

There is need for developing a seed policy and program in the Sudan to ensure that technology generation and transfer efforts have achieved their objectives.

CHAPTER III

The Study

Part I Background Report

Part II Functional Analysis

Part III Institutional Analysis

Part IV Human Resources

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Background Report

Agriculture in the Economy of the Sudan

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PART I

BACKGROUND REPORT

AGRICULTURE IN THE ECONOMY OF THE SUDAN

Section 1

AGROECOLOGICAL CHARACTERISTICS

A. Geographic Situation

The Sudan is a country of nearly 2,500,000 square kilometers with a population of 21,593,000. It lies between latitude 3 degrees 53' N and 21 degrees 55' N and longitude 21 degrees 54' E and 38 degrees 30' E. It is bounded in the north by Egypt, on the northwest by Libya, on the northeast by the Red Sea, on the southeast by Ethiopia, on the south by Kenya, Uganda and Zaire, and on the west by Chad and Central African Republic.

B. Topography

The country consists essentially of vast plains interrupted by rolling country and a few widely separated hills or mountains. It is divided from south to north by the Nile and its tributaries. Jebel Marra comprises an elevated area (above 1000 m) west of El Fasher in Darfur Province. There is the volcanic massif which rises 1500 m above the surrounding rocky hills and plateaus of the basement (Jebel Marra is 3070 m above sea level). The western slope of the massif, which receives the highest rainfall, is drained by perennial rivers (Wadi Azum and its tributaries). They flow over fertile flood plains and terraces appear at both sides of the valleys.

The Nuba Uplands include isolated steep hill ranges (up to 1600m) and dissected plateaus (at 700 - 1000 m altitudes) and gently undulating clay plains in the intermontane valleys and plains (at an elevation of 500 - 750 m).

The Red Sea area consists of a coastal plain and small hills and valleys.

The Eastern and South Eastern Uplands and plains of the Sudan include mountains up to 3000m, high plateaus, lower hills, undulating plains and swamps. Within this region, three areas of high altitude occur.

1) Acholi, Imatong and Dongotona mountains (1000 - 3000 m).
2) Didinga Hills (1000 - 3000 m).
3) Boma Hills and adjoining plateau (1000 - 2200 m).

In the piedmont, which includes all the footslopes of the Ethiopian highlands as far as the Gedaref, as well as the footslopes of the Imatong mountains in the south, the topography is undulating, dissected by streams with strong eroded valley sides. There are large areas of steep and rolling land and isolated Jebels and ranges, as well as flat, old erosion surfaces, plains and depressions. The arid southeastern plateau consists of undulating clay plains around eroded clay hills and plateaus (elevation up to 1700 m).

In the Ironstone Country the land slopes gently down from the Nile Congo divide. It is dissected by streams and broken by hills and rock outcrops. There are some flat surfaces but stream erosion has caused much of the land to be undulating or rolling. The major part of the Ironstone Country is made up of a gently undulating plateau dissected by shallow valleys in a reticulate pattern. The elevation is mainly between 400 and 800 m.

In the Green Belt the area consists of plateaus dissected by numerous valleys in a fine pattern, generally between 750 - 100 m above sea level. Some higher peaks and plateaus occur, e.g., Aloma plateau, south of Yei is 1150 - 1250 m.

C. Climate

The Sudan lies entirely within the tropics. It has a predominantly continental climate. The Red Sea introduces certain maritime characteristics, but these are confined to the narrow coastal plain and eastern slopes of the Red Sea Hills. Generally the country is one vast plain, broken only by Jebel Marra and the Nuba Mountains. Except in the Sudd region, where there are extensive swamps, there are no lakes or inland water surfaces large enough to produce even local climatic effects. To the west and north the plain extends far beyond the frontier, and to the east and south it is limited by the Ethiopian plateau and the highlands of East Africa and Zaire.

Two main flows of the wind can be distinguished, i.e., northerly and southerly winds. The northerly air masses are extremely dry because of their continental origin and descent from higher altitudes as they move south. The maritime influence of the Mediterranean Sea is sometimes felt in the northern Sudan but that of the Red Sea, though of considerable local importance near the coast, is negligible inland. The southerly winds are more uniform. They originate in the Indian and Atlantic oceans, but the long and slow passage over East and Central Africa removes most of their humid characteristics. These winds are, however, maritime when they reach the Sudan and cause rainfall in the autumn. Climatically the Sudan can be divided into three main regions:-

1) North of latitude 19 degrees N., which is a desert region, where the dry northerly winds prevail throughout the year and rainfall is infrequent. The mean daily maximum temperature is 24 degrees C in January and 49.5 degrees C in June.

2) South of latitude 19 N, which has a typical tropical continental type climate. It is dominated by the movement of the inter-tropical convergence between the dry northerly and moist southerly winds.

3) The Red Sea Coast and Eastern Slopes of Red Sea Hills, where the northerly winds prevail throughout the year but the climate is modified by the maritime influence of the Red Sea. The mean daily maximum temperature at Port Sudan is 27.1 degrees C in January and 40.9 degrees in June.

There are three other regions that have specific local climatic conditions:

1) Jebel Marra, which is typified by more rainfall than the surrounding country, concentrated into a short rainy season;

2) Eastern and South Eastern Uplands, which are typified by high rainfall, a medium wet season, and a cool winter; and

3) The Arid South Eastern Plains, which consist of undulating clay plains around eroded hills and plateaus. The climate is arid, with no marked wet season.

D. Soil Regions of the Sudan

There are sixteen major soil regions that have been distinguished, according to Purnell and Venema (1976). These are illustrated in Map 1.1, Soil Regions of the Sudan. The sixteen regions are identified in Table 1.1, Agroecologcal Characteristics in the Sudan, by an alpha character from Map 1.1. In addition to the soil types, Table 1.1 also briefly describes: area, % of land; rainfall; ecological zones and vegetation.

E. Vegetation

Climate and soil, in conjunction with overgrazing, cutting, burning and cultivation primarily determine the geographic distribution of the vegetation. The major divisions of the vegetation are determined by rainfall and the sub-divisions by soil type. The biotic factor is at least as important as the physical environment in determining the changing nature of the vegetation. Five major ecological zones can be recognized according to the classification of Harrison and Jackson (1958): I Desert; II Semi-Desert; III Woodland Savannah; IV Flood Region; and V Montane Vegetation.

These ecological zones and their sub-divisions and specific areas are illustrated in Map 1.2, Vegetation of the Sudan. Examples of vegetation are also discussed briefly in Table 1.1.

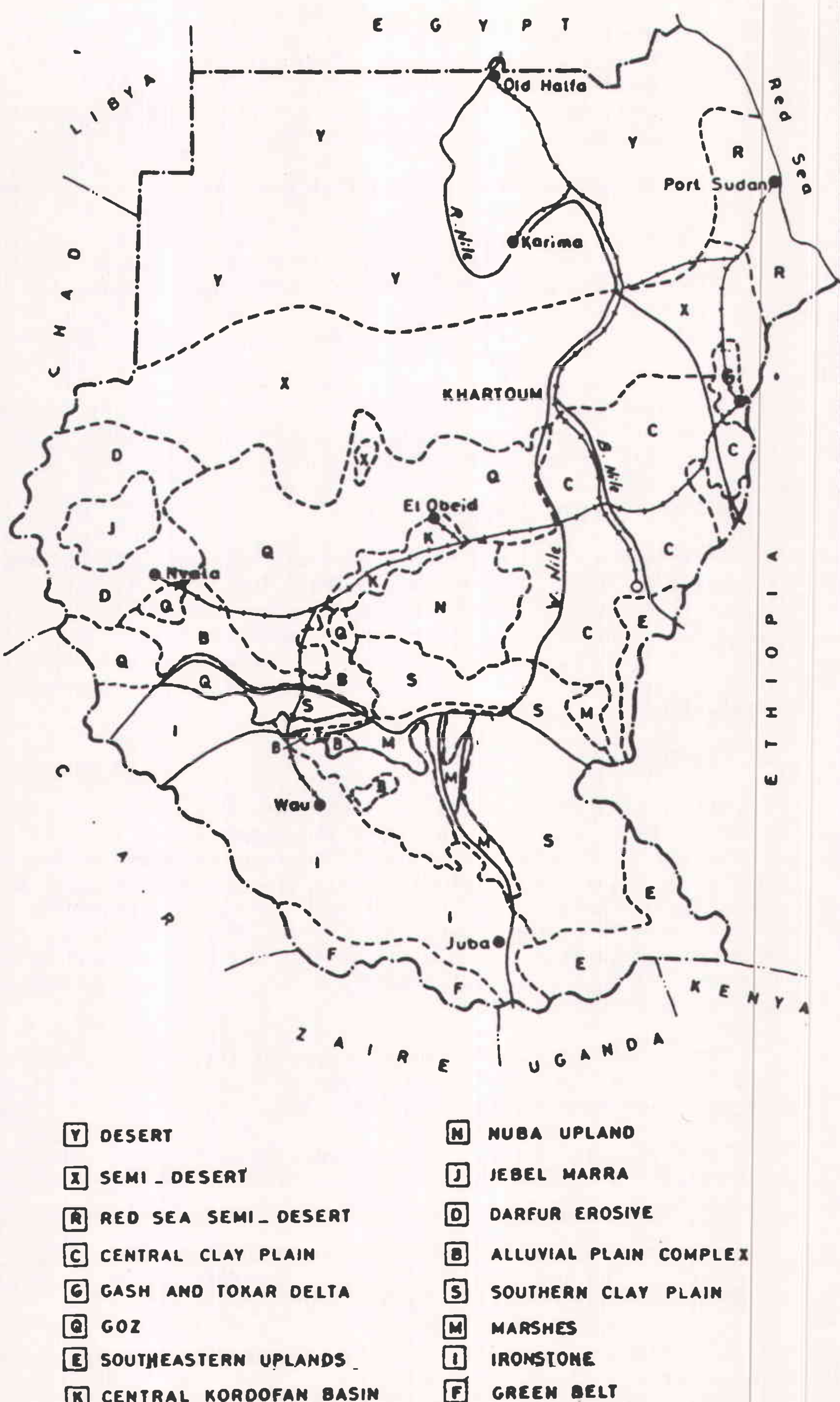
These are not intended to be exhaustive lists of species, but rather descriptions of species types characteristic of the formation.

F. Hydrology

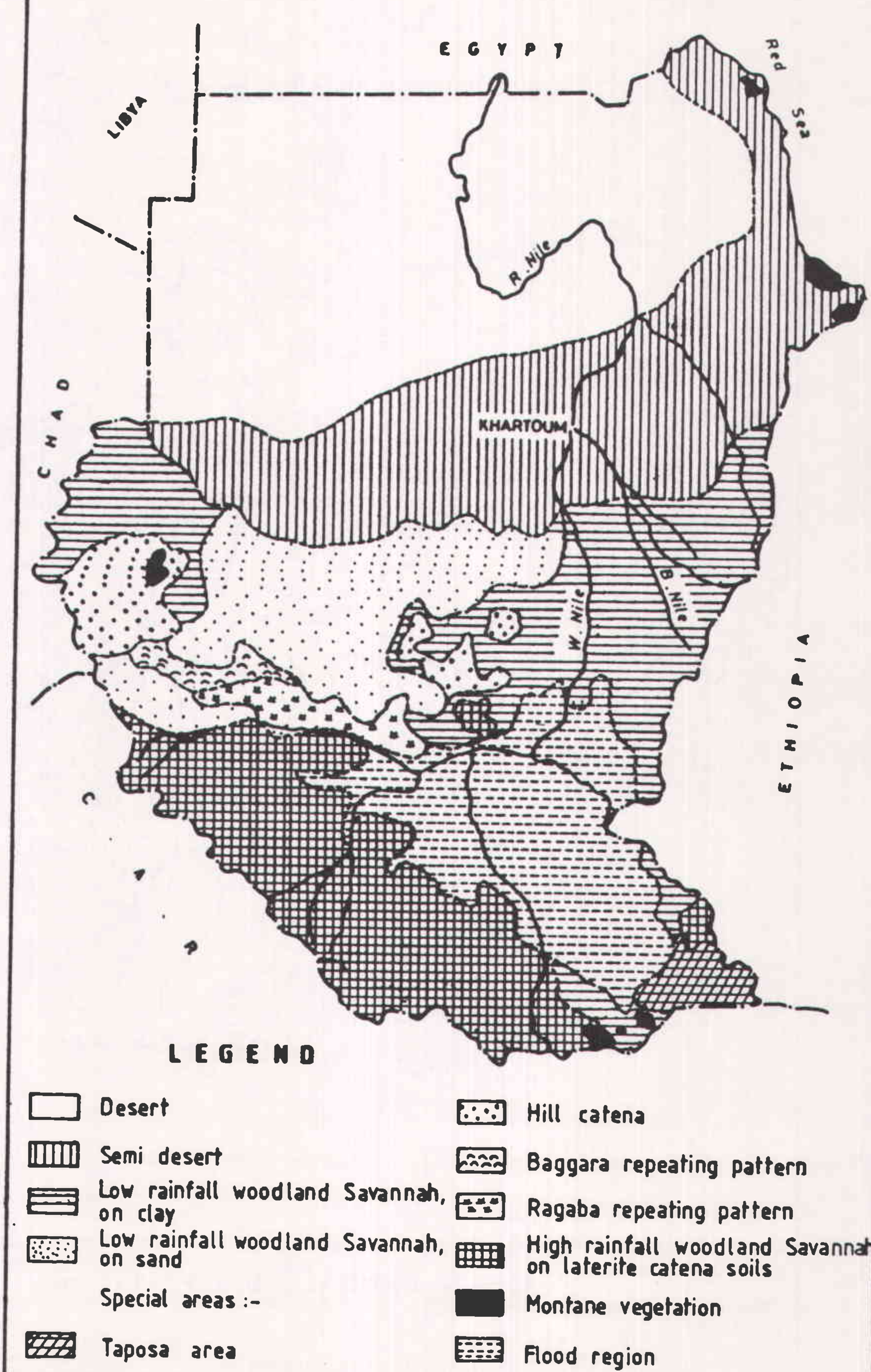
Water in the Sudan is obtained from the Nile system, underground supplies, catchment areas and rainfall.

The total length of the main axis of the Nile from its source at the Kagera River to the Mediterranean sea is 6,695 km. Of this total length the Blue Nile adds 800 km and the tributaries to the White Nile another 2000 km. If this is added to the length of seasonal rivers of Atbara, Dinder and Rahad, it would be evident that the Sudan has about 6400 km of Nile system within its borders.

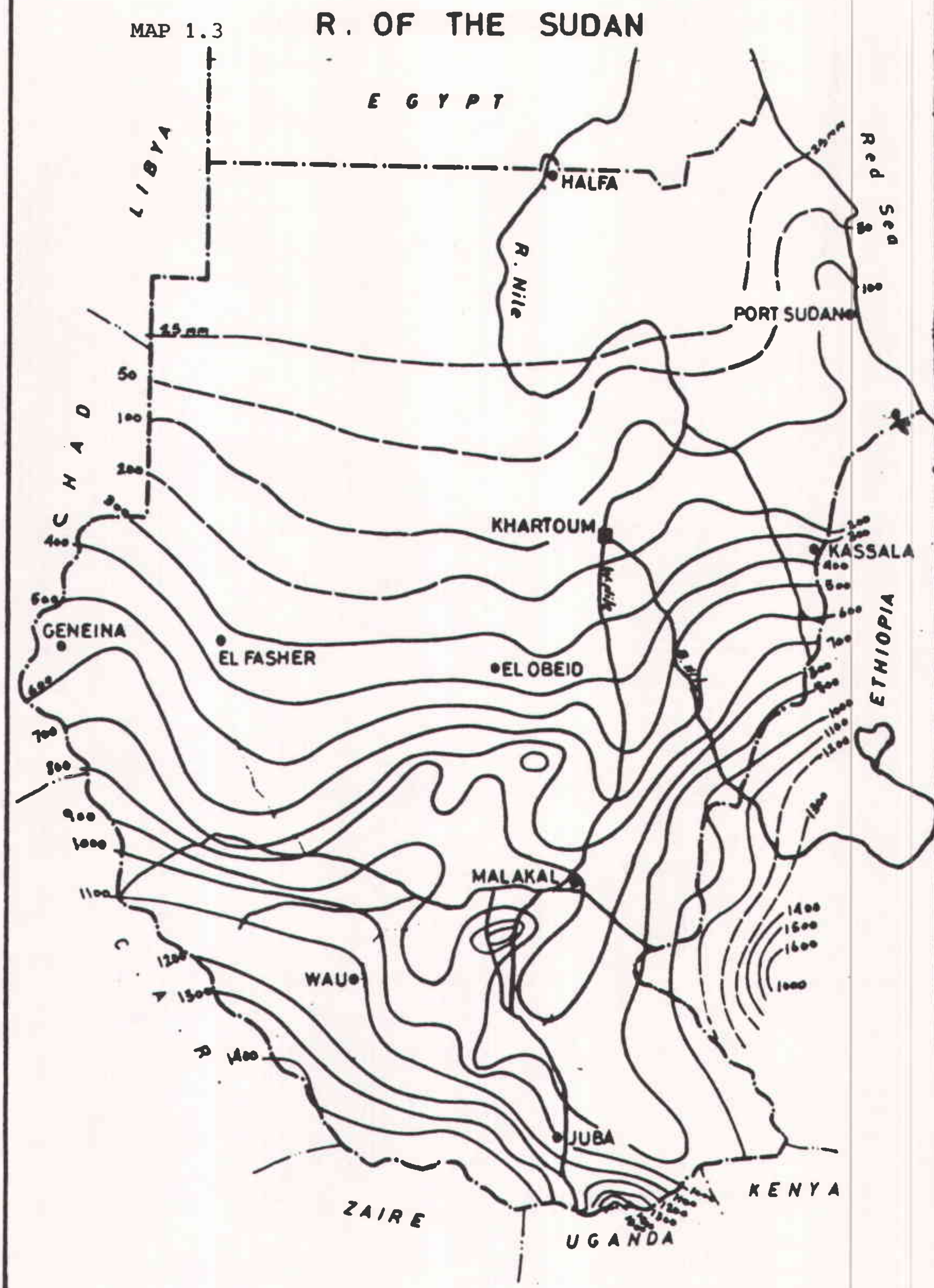
MAP 1.1 **SOIL REGIONS OF THE SUDAN**



MAP 1.2 VEGETATION OF SUDAN



MAP 1.3



MEAN ANNUAL RAINFALL(mm)

Table 1.1: Agroecological Characteristics of the Sudan

Regions (alpha character designates key to soils map)	Area km^2	% of Total Land	Annual Rainfall	Soil Types		Ecological Zones/ Vegetation
				Geological/Soil Characteristics		
1. Desert (Y)	668,000	26.7	0–75 mm	Hills, rock, sandsheets, dunes, gravelly and clayey plains	Calcareous loamy and clayey plains	Desert – Vegatation absent except by water courses and after rain showers
2. Semi-Desert (X)	387,500	15.5	75–300 mm	Basement complex plains Nubian Sandstone plains both of above with sandsheets	Deep dark sandy clay and loam deep yellowish brown with loamy topsoil over sandy clay or sandy clay loam	Semi-Desert – Varying mixture of grasses and herbs, sometimes a scatter of scrub bushes
3. Red Sea (R)	67,500	2.7	25–100 mm	Steep, rocky and stony shallow soils. Valleys are sandy and loamy		Semi-Desert – Predominant shrub is lycium persicum gradual transitia to Acacia glaucophylla and Acacia et baica with increasing rainfall
4. Qoz (Q)	240,000	9.6	200–900 mm	Deep slightly acid to neutral, low organic matter and nutrient, rapidly drained deep, well drained non-calcareous acid to neutral	Brown sand, loamy sand, sandy loam. Alluvial yellowish red loamy sand	Semi-Desert – Low rainfall woodland savannah on sand. 280–450 mm – Acacia senegal mixed with A. raddiana, L. pyrotechnica, M. cassifolia and A. Albida. 450–600 mm – Combretum cordofanum grasses are similar to A. Senegal Savannah. 600+ mm – Terminalia, Sclerocaria, Anogeisus, Prosopis

Regions (alpha character designates key to soils map)	Area km^2	% of Total Land	Annual Rainfall	Geological/Soil Characteristics	Soil Types	Ecological Zones/ Vegetation
5. Central Clay Plain (C)	212,500	8.5	200-900 mm	Arid - alkaline and calcareous, sodic, sometimes saline, semi arid-alkaline and calcareous, dry monsoon slightly acid to slightly calcareous	Dark, gray brown cracking clay, heavy very dark gray brown clay, dark cracking clays	Semi-Desert - Low rainfall woodland savannah on clay. - Three subdivisions of clay 1. Acacia mellifera thorn land 2. Acacia seyal-balanites savannah alternating with grass 3. non-clay soils along the Blue Nile have balanites aegyptiaca, acacia nubica, A. raddiana, and C. desidua C. desidua and grasses such as Aristida sp. - the acadia savannah is replaced by thorny woodland.
6. Gash Delta (G)	10,000	0.4	100-500 mm		Dark brown to dark grayish brown silty clay	Forests of acacia nilotica, tamarix orientalis and Z.spinachisti are dominant
7. Jebel Marra (J)	30,000	1.2	600-1000 mm	Shallow, stony in the volcanic area, deep well drained in the piedmont Flood plains are course, textured	Ash loam Eutric and calceric fluvisde	Montane - lower dominated by ficus spp trees and grass - in the middle zone Olea spp is common in older soil and acacia albida in volcanic soil - in the upper zone is short grassland of dwarf hyparrhenia
8. Darfur Erusive Plain (D)	92,500	3.7	300-800 mm	Undulating, weakly dissected plains surrounding Jebel Marra basement complex rocks arid, semi-arid - freely drained. Strongly dissected plain Weakly dissected	Reddish brown sandy clays and sandy clays, dark gray non-cracking sandy clay, deep clay loam, clay with cover of quartz Gravel, dark gray to dark brown imperfectly drained	Low rainfall woodland savannah on clay and on sand - as already described above.

Regions (alpha character designates key to soils map)	Area km^2	% of Total Land	Annual Rainfall	Geological/Soil Characteristics	Soil Types	Ecological Zones/ Vegetation
9. Central Kordofan Basin (K)	20,000	0.8	500-800 mm	Flat gently sloping plain eolian, alluvial and colluvial sediments	Dark reddish brown coarse loamy topsoil; dark red, fine loamy subsoil with clay accumulation - acid yellowish red soils are associated	Low rainfall woodland savannah on sand - as already described above
10. Nuba Upland (N)	65,000	2.6	500-800 mm	Shallow, fertile plateau Clay plains Eastern plains Central plains Western plains	Deep dark red Dark greyish Brown cracking clay Imperfectly drained vertisols Very dark grey nearly black pellic vertisols dark reddish brown clay	Low rainfall woodland savannah on clay and on sand - as described above Hill catena: - ficus species on rocky - summits - tree species such as Boswallia papiyrifera and combretum hartem-ianum - grasses such as hypanhania sp. - anogeissus schimperii
11. Complex of Alluvial Plains and Channels (B)	60,000	2.4	500-900 mm	Old alluvial plains two summits Baggera repeating pattern Ragaba overflow plain	Alternating non-cracking clay and stabilized sanddunes Dark grey cracking clay non-cracking clay loam sandy clay loams	Baggara catena: - in the flat non-cracking clay area there is a scanty grass cover - in the stabilized dune there is variable vegetation such as Aristida sp. sporobolis marginatus, A. mellifera and A. seyal and salty grasses Raqaba: - scanty grass cover - A. seyal open grassland - Setarria incressata and hyparrheniarufa

Regions (alpha character designates key to soils map)	Area km^2	% of Total Land	Annual Rainfall	Geological/Soil Characteristics	Soil Types	Ecological Zones/ Vegetation
12. Southern Clay Plains (S)	247,500	9.9	700-900 mm	Highlands-non-flooded	Yellowish sands and loamy sands	High rainfall woodland savannah on laterite irtena soils
				Intermediate land	Dark grey cracking clays	For intermediate rainy season - acacia seyal-balanites savannah
				Toich	Dark grey cracking clay - high organic matter hydro-morphic gelysols - non-cracking	- grassland dominated by hyparrhenia rufa as seteria incrassata
13. Marshes (M)	40,000	1.6	900-1000 mm	Peaty surface layer of under composed organic matter mixed with clay overlaying gleyed, clayey subsoils	Dystric of Eutric Histols Humic Gleyscols and Eutric gleysols	Flood Highland - 4 types of forests 1) Hyphaena thebaica 2) broad leafed 3) mixed Acacia 4) A. seyal Intermediate - dominated by grassland permanent swamp - Cyperus Papayrus
14. Ironstone Country (I)	237,500	9.5	900-1300 mm	Catenary toposequence	Reddish brown with solid or fragmented iron pan	High rainfall woodland savannah on laterite catena soils
3 zones:	Caterary sequence:			1. Plateau	Sandy loam,	
				2. Dissected plateau and jebel	Sandy clay loam	
				3. Transition	Colluvial sandy loam to sandy clay, skeletal, hydromorphic	
15. Green Belt (F)	25,000	1.0	1400 mm		Deep red, variable clay, shallow skeletal, hydromorphic	High rainfall woodland savannah on laterite catena soils

Regions (alpha character designates key to soils map)	Area km^2	% of Total Land	Annual Rainfall	Geological/Soil Characteristics	Soil Types	Ecological Zones/ Vegetation
16. Eastern and South-Eastern Eastern Uplands and Plains (E)	105,000	4.2	1000-1600 mm	Variable basement complex, rocks and lava, mountain area	Medium and fine red or brown acid clay and loam	Montane, taposa and low woodland savannah - lower slopes similar to woodland
				Piedmont	Variable lithosols and nitosols	- drier area Boswellia papyrifera - 1500-2600 m Syzgium sp., grassy patches
				Plains	Grey cracking clay, sodic and saline	- 2600-3000 m - fire climax mountain meadow

Hydrological studies of the Nile in Sudan began in 1905. From the long-term records of discharges of the Nile System the average annual discharges at various points are as follows (Hurst, 1946) :-

Bahr el Jebel upstream of Sudd	24×10^9 m3
Bahr el Jebel downstream of Sudd	12×10^9 m3
Sobat mouth	12×10^9 m3
White Nile at Khartoum	24×10^9 m3
Blue Nile at Khartoum	48×10^9 m3
Atbara mouth	12×10^9 m3
Nile at Wadi Halfa	84×10^9 m3

In addition to the Nile system, the Sudan has an underground water supply which depends on both local geology and local rainfall, except in a few places where deep-seated supplies depend on rainfall at some distance from the natural underground reservoir.

In the northern desert region there are two potential sources of underground water. The first is a permanent water table in sandstones of the Nubian series, often at considerable depth, but locally bared by erosion to form oases in mudstone layer. The second source is local concentration of subsoil water along discharge lines. In the sandstones of the west these are abundant and reliable. In areas of crystalline rock resources water supply is restricted, except along the line of major wadies.

In the central Sudan, underground water supplies are usually poor because of the impervious thick sheet of clay which forms the surface of the plain. Isolated hills are often surrounded by coarse, pervious soils and local supplies of water are often found in pools in such hills, e.g., Jebel Moya, and in wells near the foot.

The Basalt country of Gedaref has water in joints in the loam. The volcanic areas of Darfur are similiar. Sandstones of Nubian series are a source of fairly deep water (Wad El Huri, east of Ruffa, and between El Nuhud and El Fasher) and supplies are good.

Thick accumulations of unconsolidated sands, gravel and clays in the Um Ruwaba and Muglad depressions carry water. Areas of the Qoz frequently have small shallow supplies at the front of the sands. Water has also been found in the plain east of Bahr El Jebel at 43 m depth. In Western Equatoria, rivers are nearly perennial and shallow supplies are found in river beds during the short dry season. In the ironstone country, water is found near the base of the ironstone on the plains. In Eastern Equatoria, hills have perennial small streams.

Rain water is collected in catchment areas in the form of natural large pools (Fula) and pools locally made by man (Haffir). This water is stored for drinking purposes and is utilized during the dry season.

G. Agro-Ecological Zones

Agro-ecological zones of the Sudan are defined on the basis of rainfall characteristics (precipitation and evaporation), temperature and soils. The main zones are based on the availability of water, while the sub-zones are formed by temperature belts and soil types. The main zones can be divided into arid, which is virtually a desert, semi-arid, semi-humid and humid.

1) Arid Zone

The whole northern desert has no real agricultural development potential. Nomadic herdsmen graze camels and goats to make use of local rains, but in the northwest such minor possibilities do not exist. There are a number of wells and small oases and some more may be developed if deep underground water is made available. Along the Nile, thousands of hectares are developed, but the alluvial cultivable belt is only tens to hundreds of meters wide, except in a few places such as Wadi El Khowai and Kerma Basin. Crops grown in the Nile Valley include cereals, legumes, vegetables, citrus fruits and dates. The calcareous loamy and clayey soils away from the river are sodic or saline, but reclamation and improved yields are possible. Development of new cultivable areas in this region is expensive and technically difficult because of sodicity, salinity, dust and sand-storms, and the harsh climate.

2) Semi-Arid Zone

The northern part of the central clay plains and Qoz and the southern part of the Red Sea are characterized by a semi-arid climate. The semi-arid central clay plains have adequate rainfall during July to September. The soils are fertile, with high montmorillonitic clay content, which give them greater water-holding capacity. These areas are extensively used for grazing of cattle, sheep, goats and camels. In the northern part only drought-resistant crops such as millet, sorghum and sesame are successfully grown, whereas in the wetter south, cotton and legumes are also grown and mechanization is practiced. This zone is very productive under irrigation.

The semi-arid Qoz is too dry for rainfed agriculture. There is a moderate potential for extensive grazing by camels and goats near water points. Besides grazing, rainfed agriculture is practiced in the southern parts and the main crops include millet, sorghum, watermelons, groundnuts and gum arabic trees.

Much of the land in the semi-arid Red Hills is steep with rocky and stony shallow soils. The valleys are sandy and loamy. Good seasonal grazing which supports dense populations of cattle, camels, goats and sheep is available where there is perennial drinking water east of the Tokar delta and near Port Sudan. The southern Red Sea coast has low winter rainfall and soils are developed from marine sediments. This area is only utilized for poor localized seasonal grazing to support nomadic herdsmen. Development possibilities appear to be poor except for a few valleys bordering the hills. The Tokar and Gash Deltas are special areas in this semi-arid zone because flush irrigation is possible from the Baraka and Gash rivers in June to September. The main crops in these deltas are cotton, castor, millet, sorghum and vegetables.

The main limitations for agriculture in the semi-arid zone of the Darfur Erusive plain are the inferior physical properties of the soils i.e., surface sealing, poor infiltration and deep subsoils. There is, however, good potential for forestry and grazing. The "wadi" flood plains and terraces, with colluvial and alluvial soils are intensively cultivated.

The main limitation to agriculture in the semi-arid Central Kordofan Basin is the low nutrient status of soils, low moisture availability and susceptibility to erosion. However, with better methods of land management, shifting cultivation and grazing can be improved.

3) Semi-Humid Zone

The semi-humid zone includes areas with rainfall ranging between 400 and 800 - 1000 m. Included in this zone are the southern parts of the central clay plains and Qoz, Nuba Uplands, complex alluvial plains and channels, Jebel Marra and parts of the Darfur Erusive plain.

The central clay plains in this zone are fertile, and rainfall is adequate to support early and medium maturing crops of sorghum, sesame, cotton, sunflower, and maize. Mechanization is needed in this zone to cope with the heavy tillage requirements. Grazing is extensively practiced. There is a good potential for agricultural development and improved yields but nitrogenous and possibly phosphatic fertilizers are necessary, and erosion control is needed because of the high run-off. There is potential for building small dams for supplementary irrigation.

The Qoz, with semi-humid climate, is less susceptible to drought and a wide variety of crops, including millet, sorghum, groundnuts and gum arabic trees are grown. Grazing by cattle, sheep, camels and goats is practiced.

The hill soils of the Nuba Uplands have little available water held in soil, unfavorable topography and erosion hazards which limit crop production to some small patches. The cracking clays, however, are quite suitable for small and large-scale production of cotton, sorghum, sesame, millet, etc., as well as grazing.

In the Baggara catena of the complex alluvial plains and channels, the locally eroded soils are only suited to grazing. The coarse and medium-textured soils are suitable for fruit and vegetable production as well as other crops. The cracking clays of the depressions are annually flooded and are suited to paddy rice as well as seasonal grazing. The cracking clays of the Raqaba catena are flooded and are only suitable for small-scale cultivation of flood-resistant crops.

The clay soils of Darfur Erusive plain, lying in the semi-humid zone, are quite suitable for mechanized farming, grazing and forestry.

Within the Jebel Marra area rainfall is between 600 and 1000 mm and is concentrated in a short season. Winter temperatures are among the lowest in the Sudan. Because of the climatic conditions, the area has a potential for some crops and fruits which are not grown elsewhere in the Sudan, e.g., grapes. The volcanic massif, especially the valleys, are suited to the cultivation of tropical and temperate fruits and vegetables, and small-scale irrigated agriculture is possible. There is also considerable grazing potential during the wet season. Very steep slopes should remain under managed forest to avoid erosion.

The piedmont of Jebel Marra is very fertile. Soils are deep, well drained and with good water-holding capacity. Rainfall is sufficient for the cultivation of rainfed crops such as tobacco, wheat, potatoes, tomatoes, onions, grapes and deciduous fruits, and locally supplementary irrigation is possible. The grazing potential of the area is high but is not fully exploited. Susceptibility to erosion is a major limitation to agricultural development of the land.

The flood plains and terraces of Jebel Marra are superior agricultural land. Soils are medium or coarse textured and fertile with good water-holding capacity, and good drainage. In Azum Valley there is considerable potential for pump schemes which can produce tobacco, potatoes, and tomatoes.

The area bordering upper and middle Azum Valley consist of dissected and eroded land which is less fertile than the flood plains and terraces. The clays are suitable for forestry, grazing and small-scale mechanized farming. Measures are, however, needed to increase rainwater infilteration into soil and to control erosion.

The basement hills and plateaus of Jebel Marra have shallow, stony, compact and difficult-to-work soils. Cultivation is very sparse and restricted to some hill foots, and accordingly there is little potential for development.

4) <u>Humid Zone</u>

Rainfall in this zone is above 900 mm. The region consists of the southern clay plain, ironstone country, green belt and eastern and south eastern uplands and plains.

The highlands of the southern clay plain are not subject to flooding. They are used at present for grazing because soil fertility and moisture-holding capacity are low. The medium-textured soils are often over-cultivated and over-grazed.

The intermediate land is flooded or waterlogged throughout the wet season but waterless in the dry season. Cultivation is limited to paddy rice to make use of the seasonal flooding.

Another part of the southern clay plain is flooded during longer periods than the intermediate land. It is only utilized for grazing.

The climate of the ironstone country is a wet monsoon with 950-1400 mm rainfall in 3 - 4 months. In the plateau, shifting cultivation is practiced on the deeper soils (sorghum, maize, cassava, groundnuts, etc.). Productivity is low because of limited cultivable land, low fertility, low water-holding capacity and size and shape of patches of arable land. At present grazing is limited by tsetse. The dissected plateau and Jebels Zone is suited to the cultivation of tobacco, tropical fruits, coffee and upland rice. The valleys in this region are wide with hydromorphic colluvial - alluvial soils. They have available surface-water, and traditional farming is the main activity (sorghum, cassava, maize and other crops). Wet-season grazing is very important for cattle herds, which spend the dry season in the clay plains. There are good opportunities for production of kenaf and paddy rice. Supplementary irrigation for citrus fruits and vegetables is possible on a small scale near perennial rivers.

In the green belt, the northern flank of the Nile - Congo divide has high rainfall (1200 - 1600 mm) and only a short dry period (1 - 2 months). Many crops can be grown, e.g., cotton, tropical fruits, coffee, tobacco, oil seeds, sugarcane, etc., as well as food crops such as sorghum, maize, groundnuts, upland and paddy rice. Cattle grazing is prevented by tsetse flies.

Soils and climate within the eastern and southeastern highlands are suitable for the cultivation of arabica coffee, tea, potatoes, etc. The steep slopes and summits of the mountain groups are suited to forestry and controlled grazing. In the piedmont, the soils are fertile and the climate is relatively moist. A variety of crops are grown, including tobacco, fruits, tea, coffee and food crops. Commercial forestry is also possible, and much of the area produces good grazing.

H. Population

Size and Distribution

To date there have been three population censuses in the Sudan: 1956, 1973 and 1983. The total population was estimated to be 10,263,000 14,819,000 and 20,564,000 for these years, as shown in Table 1.2. Between 1973 and 1983 the total population increase was 39%. The three southern regions: Equatoria, Bahr El Ghazal and Upper Nile, showed the highest rate of change, followed by Darfur, the Eastern Region and Kordofan. The Central Region had the least change in population: 5.4% between 1973 and 1983. With respect to distribution of the population, the Central Region was largest, with 19.5% of the total population in 1983, followed by Kordofan and Darfur, each with 15%. The population in Khartoum Province was only 8.8% of the total population. The Northern Region had the least share, 5.3% of the population.

With respect to the population density (caput / km^2), Khartoum Province was highest through the three censuses with 85.8 individuals per square km in 1983, followed by the Central Region (29.5), Bahr El Ghazal (10.58) , Darfur and Kordofan (8.2) (Table 1.3). The Northern Province is the least-inhabited area of the country, with only 4 individuals/km^2.

The Growth Rate

A number of demographic variables affect the population growth rate. The most important ones are fertility, mortality and the net migration rate. Fertility and mortality are negatively correlated with income and the social structure of individuals. The population intercensal growth rate was estimated to be 2.2% according to the 1973 census. After the 1983 census, the figure increased to 2.8% as an average for the whole of Sudan, which was different in the different Regions of the country, according to the net effect of the demographic variable mentioned above. It is 4.8% for Khartoum, 3.2 for the Eastern and Darfur, 3.1 for Bahr El Ghazal, 2.5 for the Central, 2.2 for the Upper Nile, 2.1 for Kordofan and 1.7 for the Equatorial Region. The Northern Region had the smallest rate of population growth, only 0.8%, mainly because of net out-migration.

Table 1.2: Geographical Distribution of Population According to 1956, 1973 and 1983 Censuses.

Region	Number (1000 caput)			Distribution in percentages			Rate of Change between 1973 & 83 Censuses (%)
	1956	1973	1983	1956	1973	1986	
Northern	873	964	1083	8.5	6.5	5.26	12.3
Eastern	941	1572	2208	9.16	10.6	10.73	40.4
Central	2070	3804	4012	20.16	25.66	19.5	5.4
Kordofan	1762	2203	3093	17.16	14.86	15.04	40.3
Darfour	1339	2181	3093	12.94	14.71	15.04	41.8
Khartoum	505	1150	1802	4.92	7.76	8.76	26.6
Equatoria	903	758	1406	8.79	5.11	6.83	85.4
Bahr El Ghazal	991	1388	2265	3.65	9.36	11.0	63.1
Upper Nile	889	799	1599	8.66	5.39	7.78	100.1
Total	10263	14819	20564*				38.77

Source : Economic Research Administration, Ministry of Finance and Economic Planning (Planning)
Economic Survey 1985/86 - Khartoum

* 5% is added to make the total population 21,592,585, assuming estimation error of 5% downward.

* Using the following formula, 1983 population (1+r)n where "r": is the annual growth rate (2.8%) and "n": number of years. Then the 1986 total population will be 21,592,585 individuals.

Table 1.3: Population Density in Different Regions
According to 1956, 1973 and 1983 Censuses
Population Density (Caput/km^2)

Region	Inhabitable Area km^2	Population Density 1956	1973	1983
Northern	271	3.22	3.55	3.99
Eastern	342	2.75	4.6	6.47
Central	136	15.2	27.97	29.5
Kordofan	381	4.62	5.78	8.11
Darfour	374	3.55	5.82	8.27
Khartoum	21	24.04	54.76	85.8
Equatoria	198	4.56	3.82	7.1
Bahr El Ghazal	214	4.63	6.84	10.58
Upper Nile	236	3.76	3.38	6.77

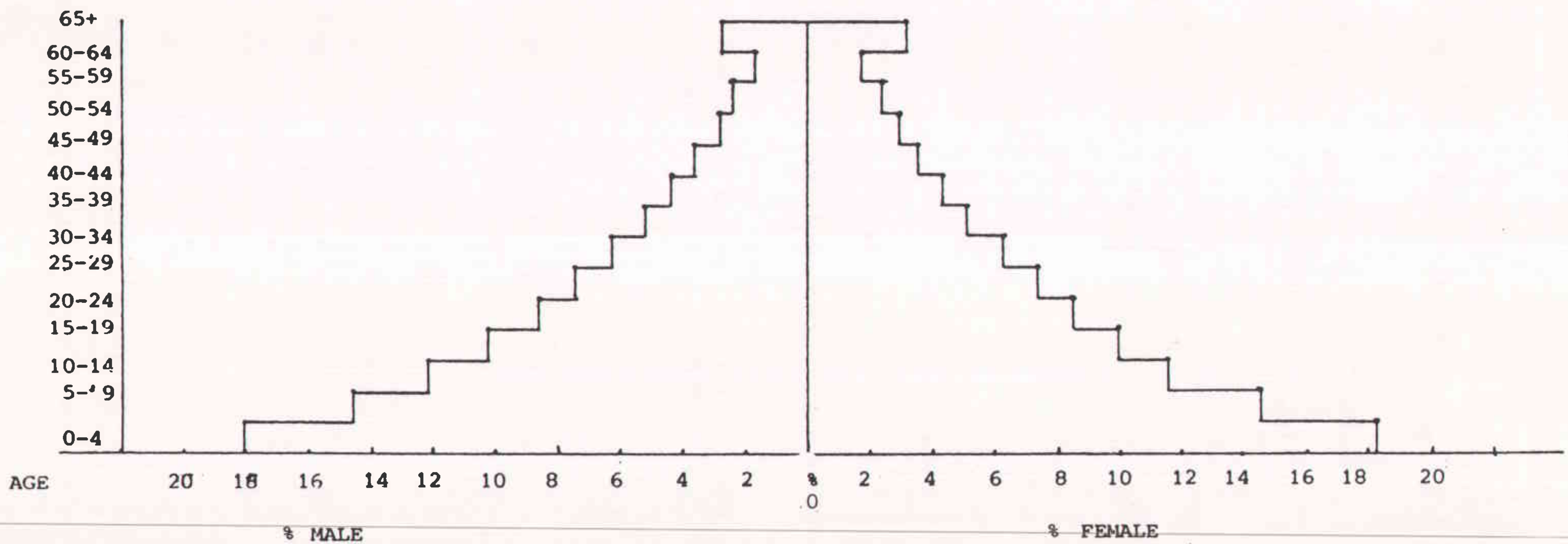
Source : Economic Research Administration, Ministry of Finance and Economic Planning (Planning) " Economic Survey 1985/86 " Khartoum.

Table 1.4: Sudan Population by Age and Sex - 1985

AGES (YRS)	TOTAL POPULATION (000'S)	MALES (000'S)	%	FEMALES (000'S)	%
All ages	21,211	10,758		10,453	
0-4	3,851	1,961	18.2	1,890	18.1
5-9	3,083	1,569	14.6	1,514	14.5
10-14	2,527	1,299	12.1	1,228	11.7
15-19	2,138	1,096	10.2	1,042	10.0
20-24	1,823	0,931	8.7	0.892	8.5
25-29	1,549	0,788	7.3	0,761	7.3
30-34	1,311	0,666	6.2	0,645	6.2
35-39	1,104	0,560	5.2	0,544	5.2
40-44	0,923	0,466	4.3	0,457	4.48
45-49	0,765	0,385	3.6	0,380	3.6
50-54	0,626	0,312	2.9	0,314	3.0
55-59	0,500	0,246	2.3	0,254	2.4
60-64	0,386	0,187	1.7	0,199	1.9
65-69	0,280	0,133		0,147	
70-74	0,185	0,087	2.7	0,098	3.2
75-79	0,105	0,048		0,057	
80 +	0,055	0,024		0,031	

Source : Calculated from the United Nation, Department of Population Studies, Population projections, New York, P. 127 (1982)

FIGURE 1.1 Population Pyramid - Sudan - 1982 Census .



Age Distribution

The projected Sudan population by age and sex is shown on Table 1.4. About 51% of the total population of the Sudan lies within the working age of 15 years and less than 60; almost equally distributed between males and females. The number of children (less than 15 years of age) and the elderly (more than 60 years of age) constitute 44% and 5% of the total population, respectively. This population distribution is graphically illustrated in the attached population pyramid (Figure 1.1). The wide base of the pyramid represents the high population growth rate (2.8%). At that rate, the population will double in approximately 25 years, by 2010 A.D. The combination of the large number of dependent children and elderly comprise 49% of the population, and thus a dependency ratio of almost 100, a ratio surpassed globally only by countries such as Chad, Benin and Lao PDR, those classified as low-income economics based on GNP per capita.

About 50% of the population between 15 and 60 years old is considered to be economically active; the males constitute about 3/4 of that.

Family Size and Composition

According to the 1983 census, the total number of households in the Sudan was 2,703,148. The average size of the household was 7.6 individuals. This figure differs from one region to another according to the type of family, whether nucleated or extended. The average figure was 6.0 for Khartoum, Kordofan and the Central Region, and about 5.5 for the Eastern and the Northern Region. The number of households for the three southern regions was not reported in the 1983 census, so it is difficult to calculate the average size of the family. But as the calculated averages for the other regions is less than average for the whole of Sudan, the family size in the southern regions is expected to be more than 7.6.

Migration

Three types of migration can be identified in the Sudan: internal migration, external migration, and refugees.

Seasonal migration of labor from Kordofan and Darfur to the Central and Eastern Region is the most prominent feature of the internal migration. Organized movement of labor occurs during cotton picking in the irrigated schemes and harvesting of sorghum in the mechanized schemes. In the last few years, population of the Western Region has been decreasing due to desertification, drought, and famine. Migrants settle around Khartoum and other large towns in the country looking for work and better living conditions.

External migration became a phenomenon only late in the 1970s due mainly to political and socioeconomic factors, such as low income, high inflation and consumption. No precise records are available for external migration but it is estimated, at present, to be between 350 to 500 thousand individuals, mainly to the Arab oil rich countries. Table 1.5 shows the Sudanese nationals working abroad from official records and according to occupation for the period 1982 - 1985. Although the percentages of the external migration to the total population is insignificant (1%), it is selectively draining highly qualified professionals and skilled labor.

Table 1.5: Sudanese Nationals Working Abroad According to Occupation from Official Records (1982 - 1985)

Occupation	1982/83	1983/84	1984/85	Total	% of overall migrants
Technicians & Professionals	299	493	369	1161	5.0
Administrators	290	323	146	759	3.3
Clerks and Accountants	447	800	509	1756	7.6
Service Workers	117	151	193	461	2.0
Sales Workers	21	188	34	243	1.1
Agricultural	404	1461	1002	2867	12.4
Cooks	181	444	113	738	3.2
Tailors	52	233	17	302	1.3
Carpenters	47	201	10	258	1.1
Artisans	131	390	53	574	2.5
Machinists	160	309	49	518	2.2
Electricians	81	255	38	374	1.6
Painters	103	95	3	201	0.9
Sanitary workers	25	104	21	150	0.7
Builders	85	325	16	426	1.8
Drivers and Ticket Collectors	1194	1416	490	3100	13.4
Typists	146	49	9	204	0.9
Unskilled labor	3308	4474	1186	8968	38.9
Overall Total Number	7091	11711	4258	23060	99.9

Source: Department of Work

Table 1.6: Population Distribution According to Region and Living Environment from 1983 Census

Region	Urban	Rural	Nomads	Total
Northern	230,341	802,414	50,269	1,083,024
Eastern	638,833	1,010,700	558,676	2,208,209
Central	825,024	2,943,246	244,233	4,012,543
Kordofan	338,539	1,923,716	781,039	3,093,291
Darfour	316,152	2,307,803	469,744	3,093,699
Khartoum	1,343,651	370,648	88,000	1,802,299
Equatoria	176,544	1,229,637	-	1,406,181
Bahr El Ghazal	181,925	2,083,585	-	2,265,510
Upper Nile	52,510	1,547,090	-	1,599,605
Total Sudan	4,153,559	14,218,844	2,191,961	20,564,364

Source : Ministry of Finance and Economic Planning, Economic Research Administration Department of Statistics - 1983/84.

The third type of migration is the influx of refugees from the countries neighboring Sudan; mainly from Ethiopia, Uganda, Zaire and Chad. In 1985 the total number of refugees in the Sudan was estimated to be 1,164,000. They mainly live in refugee camps and contribute very little to the labor force.

Rural Population and Labor in Agriculture

According to the 1983 census the rural population in the Sudan is estimated to be 80% of the total population (Table 1.6). About 75% work in agriculture or other related activities.

Share of agriculture in GDP

Agricultural production dominates other sectors in the GDP in the Sudan. Although the relative share decreased through the eighties, it is still leading. It decreased from 35.6% in 1980/81 to 28.2% in 1984/85, as depicted in Table 1.7. Shares of other sectors in the 1980s are also shown in the table.

Country Development Indicators

Selected indicators of development are illustrated for three main categories in Table 1.8: structural indicators; development performance; and agricultural performance.

Table 1.7: Estimates of Gross Domestic Product at Current Producer Prices by Economic Activity (in LS. Millions)

	1980/81		1981/82		1982/83		1983/84		1984/85	
	Value	% Share	Value	% Share	Value	% Share	Value	% Share	Value	% Shar
Agriculture	1770	35.6	2062	34	2320	30.8	2664	29.6	2929	28.2
Commerce	1091	22	1349	22.2	1755	23.4	2088	23.2	2442	23.4
Manufacturing and Mining	378	7.6	470	7.8	627	8.4	783	8.7	960	9.2
Transport and Communication	487	9.8	647	10.7	754	10.0	787	9.9	1058	10.1
Construction	216	4.3	280	4.6	390	5.2	502	5.6	577	5.5
Electricity and Water	92	1.9	117	1.9	160	2.1	203	2.2	244	2.3
Government Services	514	10.3	610	10.1	806	10.7	969	10.8	1190	11.5
Other Services	424	8.5	528	8.7	709	9.4	900	10.0	1021	9.8
GDP at Current Producers Prices	4972	100	6063	100	7521	100	8996	100	10421	100

Source : Bank of Sudan, "Twenty-sixth Annual Report" Khartoum 1985.

Table 1.8: Country Development Indicators
1986 (World Bank and other available data)

a. Structural Indicators	
Area (thousands of square kilometers)	2,505.8
Population (millions), 1983 (official figure of 1983 census)	21.6
Average annual growth rate of population (%) 1983	3.1
Percentage of rural population, 1983	80
Percentage of population of working age (15-64 years), 1983:	52
Adult literacy rate (%), 1983	22
Life expectancy at birth (years), 1983	48
Percentage of labor force in agriculture, 1984/85	78
Contribution of agriculture to GDP (%), 1981/82 - 85/86	30
Percentage share of agriculture in merchandise exports, 1980/81 - 84/85	96.6
Percentage share of agriculture in merchandise imports, 1980/81 - 84/85	20.0
Arable or cultivable land per capita (ha), 1983	3.89
b. Development Performance	
GNP per capita (US $), 1985	375
Average annual growth rate of GDP (%), 1973-1986	1.39
c. Agricultural Performance	
Average annual growth rate of GDP of agriculture	5.15
Value added in agriculture (millions of 1981 dollars), 1981/82	1,937
Cereal imports (thousands of metric tons), 1980/81 - 84/85	378
Fertilizer consumption (kilograms of plant nutrient per hectare of arable land), 1980/81 - 84/85	0.3 Arable 7 Irrigated 85 for Cotton
Average index of food production per capita (1974-76=100), 1981-83	84

Section 2

PRODUCTION SYSTEMS

The Sudan has virtually unlimited agricultural resources, and the potential for production of a wide range of annual and perennial crops is considerable. However, financial inputs and efforts are necessary for the achievement of production targets. The total area of the Sudan is 250 million ha. The cultivated land, which includes arable crops, vegetables and fruits, is about 9,822,000 ha. Forested areas constitute 94 million ha and pastures occupy 66 million ha. Areas not suitable for agriculture because they are too dry or swampy occupy 80 million ha.

Of the land that is cultivated, most (83%) is privately cultivated. Details of the area of cultivated lands by sector are displayed in Table 2.1.

Table 2.1: Area of Cultivated Lands by Sector ('000 ha)

Sector	Area	% of Total
Private	8115	83
Cooperative	198	2
Public	1509	15
Total	9822	100

The distribution of the cultivated lands in individual holdings is illustrated in Table 2.2. As is readily evidenced, most landholders have relatively small parcels of land, i.e., less than 10 hectares. As a result, 77% of the farmers cultivate less than nineteen percent of the land under cultivation. At the other extreme, 7% of the landholders have farms larger than 50 hectares. This small group of large landholders controls over 70% of the total cultivable land.

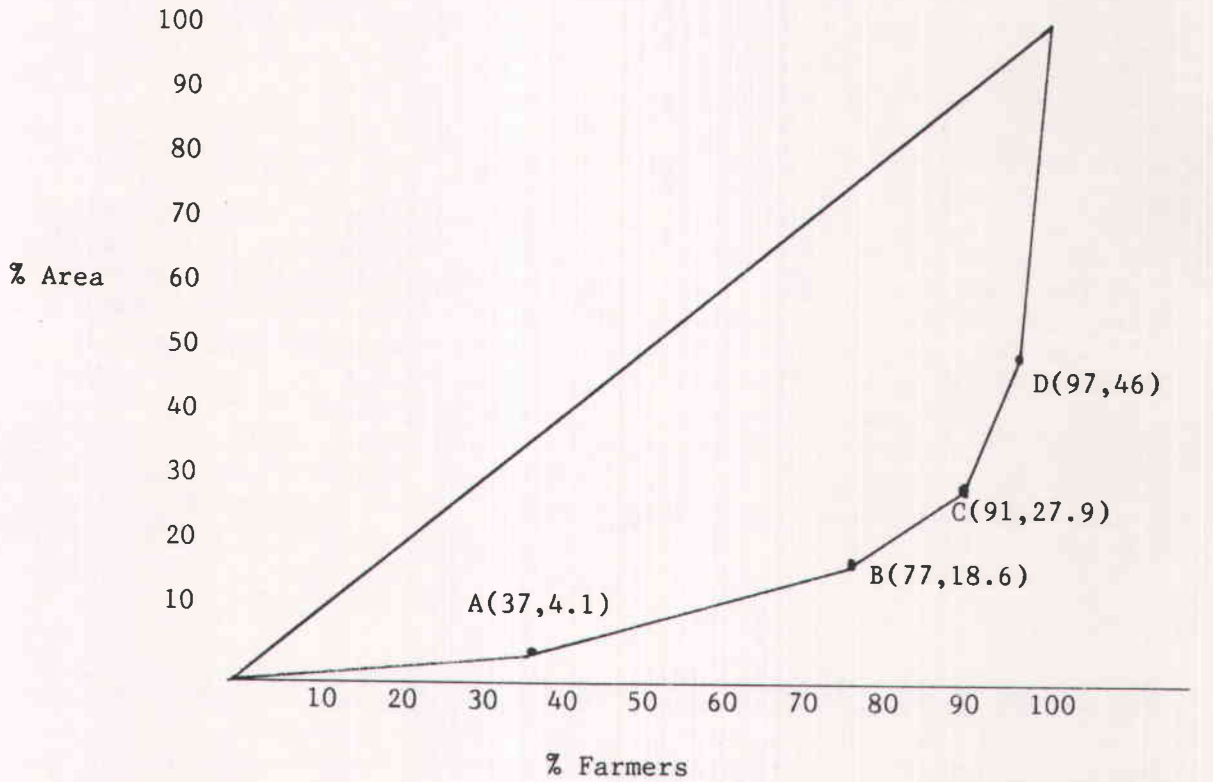
The phenomenon is illustrated in Figure 2.1, Land Tenure, Sudan 1987. As the Lorenz curve indicates, the landholdings curve, established by the % of farmers by the % of area, varies significantly from the straight line, which indicates equitable (1 to 1) distribution.

There are three main types of production systems: rainfed, mechanized and irrigated.

Table 2.2: Size Distribution of Agricultural Landholdings

Size of Land-holdings	Holders Number	%	Cumulative %	Area ('000 ha)	%	Cumulative %
1	53,876	12	12	28.8	0.3	0.3
1-2	23,368	5	17	32.9	0.4	0.7
2-3	40,880	9	26	120.2	1.2	1.9
3-4	16,206	4	30	72.4	0.7	2.6
4-5	33,344	7	37	150.9	1.5	4.1
5-10	178,278	40	77	1425.8	14.5	18.6
10-20	61,214	14	91	908.8	9.3	27.9
20-50	7,773	2	93	196.1	2.0	29.9
50-100	15,199	3	96	1154.9	11.8	41.7
100-200	4,011	1	97	426.4	4.3	45.0
200-500	9,458	2	99	3549.2	36.1	81.1
500	3,180	1	100	1756.1	17.9	100.0
Total	446,787	100	100	9822.5	100	100

Figure 2.1: Land Tenure - Sudan - 1987



A. Traditional Rainfed Agriculture

A wide range of agricultural and horticultural crops, including sorghum, millet, groundnuts, sesame, cotton, maize, sunflower, tobacco, cassava, yams, elusine, coffee, tea, mango, citruses and vegetables are produced under rainfed conditions. Traditional farming systems include shifting cultivation, harig cultivation, and intensive cultivation.

A.1 Shifting Cultivation

In areas where land is practically unlimited and in excess of demand, e.g., southern, central and western Sudan, the normal agricultural method employed is shifting cultivation. Under this system certain areas are brought under cultivation for a time, then the farmer moves to new ground. After a few years the process is repeated. The farm size may be as small as 1 ha. By this system a primitive type of rotation is practiced. The main crops are sorghum, millet, groundnuts or sesame, depending on the district.

A.2 Harig Cultivation

As with shifting cultivation, 'Harig' cultivation can only be practiced where the available land exceeds the demand. It is practiced in the fertile clay plains with thick growth of tall grass. The important feature of the system is that it uses controlled burning, which cleans the land for cultivation and reduces subsequent weeding. This reduces costs and at the same time produces high yields. The normal procedure is to allow 2 - 4 years' growth of grasses to form a dense rank growth. Following the first heavy rains and growth of weeds, fire is set on the dense matted growth, and the new young weeds are killed. Harig cultivation is practiced in Kordofan, Blue Nile, Kassala and Upper Nile Provinces.

A.3 Intensive Cultivation

In districts where suitable land is restricted, i.e., in the neighborhood of towns, the same land is continuously cropped, leading to reduced yields. Serious problems have already started to arise. The present systems of cultivation in these overcropped areas are numerous and include:

a) mixing leguminous crops, usually *Vigna unguiculata*, or a sesame crop, with sorghum helps to reduce soil exhaustion produced by continous planting of sorghum;

b) continuous mulching by leaving grasses and weeds on the ground after hoeing to rot and provide some organic matter;

c) sowing sorghum at wide spacing so that plants can make the best use of the available nutrients in the soil;

d) sorghum stalks are cut and left lying on the ground, to be broken down by termites and thus provide a source of organic matter.

The traditional farmer in the rainlands uses simple cultural practices. Land preparation, when carried out, consists of discing and/or ridging. Crops are sown by hand in small holdings where size depends on the availability of labor to carry out weeding and other operations.

The farmer usually uses his own stock of seeds, and a wide range of different varieties are planted. The farmers never use seed dressings, fertilizers or pesticides. Crops are manually harvested.

B. Mechanized Crop Production

The total area under mechanized crop production was 3.8 million ha for the 1986/87 season. Gedarif is the largest mechanized area, followed by Damazin, Kosti, Renk and Dilling. About 80% of the farms are owned by individuals who are allocated 400 - 600 ha each. Cooperatives of 10 - 20 individuals with pooled resources are allocated about 10% of the land, and the size of holding is 600 ha. In addition about 10% of the area is allocated to private companies. The size of these holdings varies between 5000 and 15,000 ha. Generally yields are low. The recommended 3-course rotation (sorghum - sesame/cotton - fallow) is not adhered to by farmers because sesame harvesting is labor-intensive and cotton production requires expensive inputs. The tendency at present is for a continuous sorghum monoculture. Land preparation is carried out by a shallow wide-level disc when the land receives 120 - 150 mm rainfall. The number of discings varies from 1-3 depending on weed density. During the last discing operation, planting is done with a seeder box. Recommended and local varieties of the various crops are usually planted. The only subsequent cultural practice is a light hand weeding. Fertilizers are not applied. Crops are hand harvested. Sorghum is threshed with a stationary thresher or combine harvester.

C. Irrigated Agriculture

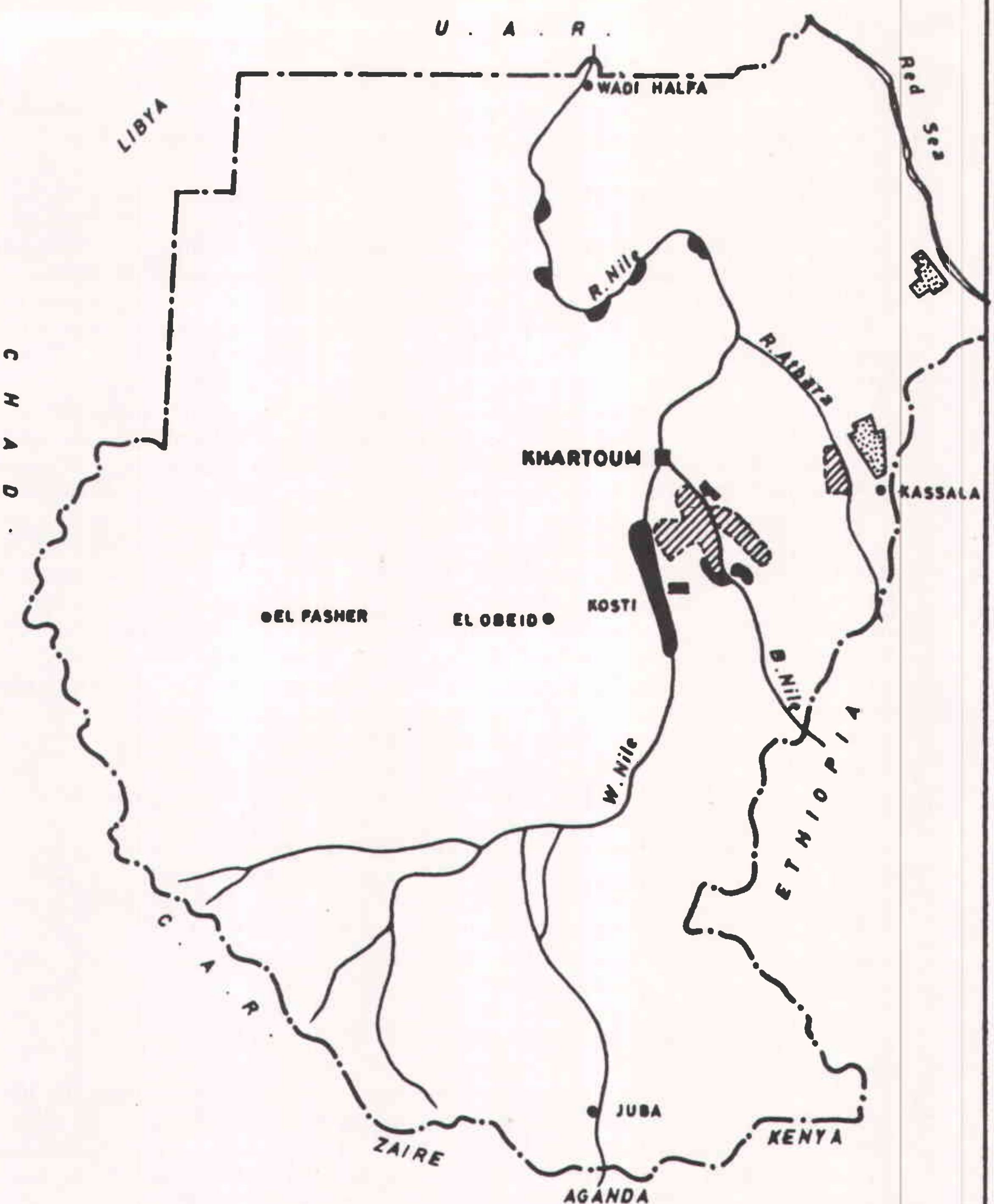
Over the centuries the inhabitants along the banks of the Nile have relied on agriculture for their livelihood. However, modern agriculture in the form of irrigated production of cash and food crops is a recent development which began with the introduction of cotton. A variety of other crops are now produced in permanent irrigated schemes, riverain areas and flush-irrigated schemes.

C.1 Permanent Irrigated Schemes

The total crop area of the permanently irrigated schemes is about 1,864,000 ha. Irrigated agricultural schemes include Gezira, Mangil, Blue Nile Pumps, White Nile Pumps, New Halfa, Rahad, Suki, Kenana, Asalaya, Guneid - Tambul, West Sennar, Abu Naama, and Northern Region Pump Schemes. In these schemes a crop rotation is adhered to. The seed bed is normally prepared by ploughing, disc harrowing and ridging. A range of crops, including cotton, groundnuts and legumes seed, sorghum, wheat, vegetables and sugarcane are annually grown. Crop seed varieties obtained from The National Seed Administration or from private sources are usually dressed with fungicides, bactericides and insecticides. The various crops, with the exception of wheat in Gezira and New Halfa, are hand sown. Wheat is drilled. Irrigation water is provided through a system of canals consisting of a main canal, branch canals, majors, minors, Abu XX's, Abu VI's and field channels. Herbicides are applied to cotton at sowing by the scheme managements. Nitrogen is applied to wheat and some sorghum at planting time. For cotton it is applied 5 - 6 weeks after sowing. Vegetables are sometimes fertilized. Insect pests are controlled by insecticides. Cotton, sorghum, vegetables and most of the groundnut crop are manually harvested, but wheat and, in certain areas, groundnuts, are mechanically harvested.

MAP 2.1

R . OF THE SUDAN



IRRIGATED AGRICULTURAL SCHEMES IN THE SUDAN

Large scale Irrigation works

Medium small scale irrigation works

Controled flooding irrigation works

C.2 Riverain

Riverain areas annually cropped are difficult to estimate because the flood varies from year to year. Small pumps are used to draw water from the Nile. Farmers all along the Nile grow vegetables, wheat (Northern Region), broad beans, pulses, fodder, citrus and date palms. The holdings are generally small, not more than 1-5 ha. The adoption of crop rotations is influenced by the market, season, soil fertility, water, labor supply and weed problems. Cultural practices are fairly simple. Land preparation consists of ploughing, discing, levelling and/or ridging.

The various crops are produced under pump irrigated conditions except for areas on the Nile banks where planting is carried out with the retreating flood water. Following crop sowing, mineral fertilizers, mainly urea, are broadcast by some farmers. Organic fertilizers in the form of farmyard manure are used to some extent. The use of pesticides is restricted to the application of insecticides. Harvesting of all crops is exclusively by hand.

C.3 Semi-Irrigated

Crops in the Tokar and Gash Deltas are grown by means of flush irrigation of the Baraka and Gash rivers. Crops grown in the Tokar Delta include cotton in the heavily watered areas, and sorghum, millet and pigeon pea (Cajanus cajan) and some vegetables in the lightly watered areas. Crops grown in the Gash Delta include castor, sorghum, millet and some vegetables. The total area planted is variable from season to season, depending on the quantity and nature of the flood. The Tokar Delta area is 40,000 ha, while area flooded by the Gash Delta is 90,000 ha.

Land allocation varies from year to year according to size and nature of the flood. The size of the tenancies varies from 2 - 20 ha., depending on the capabilities of the farmer. Before the flood land is cleared of bushes, banks are repaired and channels cleaned. Land is sown with the various crops as soon as the cultivator can move about. A sowing stick called "seluka" is used for planting. The spacing is normally 1 X 1 m. Weed growth is usually very rapid and dense, and hand hoeing is started soon after planting. On the average three weedings are necessary. Cotton is thinned when it is 4 - 5 weeks old. Crops are harvested by hand.

D Forests

Rainfed and riverain forests in the Sudan occupy about 91,000,000 ha.

D.1 Rainfed Forests

Vegetation of Equatoria Province is broad-leaved woodland. The gallery forests occur as fringes along the margins of the larger streams in the southern Sudan. They are found southwest of Yambio and in the Aloma plateau south of Yei. Gallery forests are dominated by Syzygium awariense, ebony and mahogany trees.

The depression forests occur in depressions where there may or may not be a stream but where they receive run-off in the wet season from surrounding slopes. These forests include Azza forest in Meridi District, Lotti forest towards the base of Acholi hills, Laboni forest in the Acholi Hills near the Sudan - Uganda border. The cold forests occur at the higher altitudes of tropical mountains. They are limited to the upper slopes of the Imatong and Dongotona mountains, where conifers occur. In addition to those forests, extensive areas in Kassala, Blue Nile, Kordofan and Darfur Provinces are grown with Acacia senegal (Gum Arabic).

D.2 Riverain Forests

In the Northern, Central and Southern Regions there are forest reserves on riverain land. In Shendi district there are two forests and in Dongola Basin there are three fairly extensive forests. The main forestry activity in Nile Province is trade in "dom" palm (Hyphaene thebaica). Most of the forests are on the River Atbara. Government schemes at present have plantations of neem, eucalyptus and mahogany, which are intended to provide farmers with fuel and timber poles and check wind erosion. In all the irrigated schemes of central and eastern Sudan forests have been cultivated in vast areas.

All along the Nile from South to Wadi Halfa, Acacia nilotica forests are grown.

E. Pastoralism

Pastures in the Sudan are divided into two types, i.e., natural and cultivated. Natural pastures include all the natural resources in the Savannah Region - pasture and forest land. They constitute the major source of feed for the large populations of cattle, sheep, goats and camels. The total area is about 111.5 million ha (50.2% of the total acreage). Such pastures are found in the desert, semi-desert, low-rainfall woodland savannah, high-rainfall woodland savannah, flood region and montane region. The annual dry matter produced is estimated to be 77.7 million tons. Such production can adequately support the available animal populations and even more under good management. A variety of natural grasses and herbs of good nutritional value grow, particularly under high rainfall. These include Aristida, Echinochloa spp, Setaria spp, Cynodon dactylon, Ipomoea spp., Blepharis edulis, Desmodium spp., etc. Livestock and their owners spend the wet season away from the river and water sources, but many have to move within reach of the Nile as the dry season advances. In wetter parts of the Sudan heavy rains provide excess water, but there is still lack of permanent water supplies during the dry season.

Cultivated pastures are grown under irrigated conditions and occupy about 25600 ha only. The produce is usually consumed green or as hay. The most important species are Medicago sativa (Lucerne), Dolichos lablab (Country bean) Sorghum bicolor (Abu Sabeen), Phaseolus trilobus (Philipasara), Clitoria ternata (Clitoria) and Zea mays (Maize). Productivity is usually high in comparison with natural pastures. These species have a high nutritive value and generally increase or maintain soil fertility.

Area per each of the above described production systems is estimated in the following table (Table 2.3).

Table 2.3: Types of Agricultural Production Systems
(area in '000 ha)

1. RAINFED

	Rainfall less than 300mm	300-500	500-800	800+
Traditional farming	367	2423	904	416
Traditional pastoral	13244	23320	64450	11063
Mechanized farming	-	1432	2510	72
Oasis	-	-	-	-
Desert	79800	-	-	-

2. IRRIGATED

Production Schemes	non-pump	pump
Gezira-Managil	840	-
New Halfa	170	-
Rahad	-	149
Blue Nile	-	127
Northern Region	-	28
White Nile	-	84
Elsaki	-	34
Riverain		
Individual Owned	47	189
Public-Owned	-	28

3. FORESTRY

a. Rainfed	
- Semi-desert (rainfall 400)	35780
- Low-rainfall woodland Savannah (rainfall 400 - 600 mm)	34890
- High-rainfall woodland Savannah (rainfall 600 - 950 mm)	13870
- Montane forest rainfall 950	9330
b. Riverain forestry	
- River basin forest	6
- Flood region forest	-

Section 3

AGRICULTURAL POLICY AND GOALS OF THE CURRENT NATIONAL DEVELOPMENT PLAN

A. Agriculture in the National Economy

Agriculture is the leading sector of the Sudanese economy. It accounts for 30.6% of the total GDP (1981/82 - 85/86), 96.6% of the total value of commodity exports (80/81 - 84/85), and employs 78% of the total labor force (1984/85).

Development of the agricultural sector has always been the concern of the Government, and hence its share in the development budget, though varying over the years, has always been the largest, as indicated by the following table.

Table 3.1: Agriculture's Share of the Public Development Budget
Source: Ministry of Finance and Economic Planning

Year	Agriculture's Share
1965-70	35
1970-75	27
1975-80	38
1984/85	33
1985/86	25
1986/87	25

The principal goals of agricultural development plans are:

a) to secure self-sufficiency in food;
b) to earn sufficient foreign exchange through promotion of exports;
c) to generate employment for the rural population;
d) to contribute to equal distributions of wealth between different regions;
e) to maintain, conserve and develop natural resources.

The goal of food self-sufficiency and food security has largely been achieved. Supply of food in general has been adequate except for some localized food shortages in certain seasons. Some food items are still being imported, and these constitute 20% of the total import bill. Wheat and wheat flour are the principal imported food items, representing 45% of the total value of imported food, with sugar, rice, tea, coffee and some dairy products constituting the remainder.

Details of Actual Production, Domestic Disappearance and Self-Sufficiency for 1982, 1984 and projections for 2000 are listed in Table 3.2.

Specific information on the adequecy of per capita consumption is listed in Table 3.3.

Table 3.2: Actual and Projected Self-Sufficiency for Principal Food Products 1982, 1984 and 1990
(Quantity 1000 metric tons)

Product	1982			1984			2000		
	P	DD	SS%	P	DD	SS%	P	DD	SS%
Wheat	142	433	32	169	366	46	1447	1447	100
Sorghum & Millet	3834	3650	105	2155	2378	90	5155	4196	123
Total Cereals	3976	4083	97	2324	2744	84	6603	5643	117
Oils	484	391	124	312	254	123	974	543	179
Sugar (refined)	239	501	44	427	475	90	2352	850	277
Red Meat	428	418	102	391	377	104	980	868	113
Poultry Meat (Broilers)	28	28	100	25	25	100	21	21	100
Liquid Milk	2685	2800	96	2800	2886	97	2845	2845	100
Eggs (1000 dozens)	26	26	100	33	33	100	54	146	37
Fish	30	30	100	30	30	100	90	236	38

Source: League of Arab States, AOAD, Arab Food Security Program Vol I to VIII 2nd edition (in Arabic) Khartoum 1986.

P = Production
DD = Domestic Disappearance (Production + Imports - Exports)
SS = Self-Sufficiency = P/DD

Table 3.3: Per Capita Consumption of Principal Crops

Crop	Per Capita Consumption Kg/annum	Daily per Capita Intake * (calories)	Date of Issue of Data
Sorghum	81.1	753.2	76-78
Wheat	28.0	268.9	76-78
Sugar	18.5	202.7	1979
Edible Oils & Fats	7.35	181.2	1985
Red Meat	23.5	257.5	1980
Poultry Meat	0.8	8.8	1977-78
Fish	1.6	17.5	1975-77
Milk	92.2	163.9	
Eggs	2.04	8.6	
Total	255.80	1862.3	

Source: League of Arab States, AOAD, "Arab Food Security Program" Vol. I to VIII, 2nd edition "In Arabic" Khartoum 1986.

* Transformation into calories is based on the approximate analysis of each item and then by using a conversion factor for energy source ingredients for each gram.

Government efforts to further improve the food situation are focusing on two directions:

1) Efforts to increase food supply are reflected in the increased allocation of resources for the production of food crops, whether directly in the form of increased input supply and provision of credit or indirectly through support for research and subsidies to producers in the form of support prices, as has been the case for wheat, sorghum and oilseeds. These efforts have also been reflected in Government policies to establish strategic food reserves to offset the effects of instability in food production that result from changes in climatic conditions.

2) Government's efforts to secure access of all people to food include improving purchasing power through subsidies of the basic food items, such as wheat, bread and sugar.

The goal of earning sufficient foreign exchange has partially been successful. Although agriculture continued to generate almost all the foreign exchange earned by the country (96.6% of total), the amount generated did not increase sufficiently to meet the growing needs of the country. For example, during 1980/81 - 84/85 the average value of total imports, including intermediate goods and capital goods essential for development projects, amounted to $1487.0 million, while total value of exports was $558.7 million or 37.6% of the import bill. Thus 62.4% of the country's foreign exchange needs have been met through loans, grants and commodity aid; (Total foreign debts amount to about $10.6 billion, while commodity aid during 1984/85 - 1985/86 amounted to about $363.5 million.)

Table 3.4: Value of Exports and Imports 975/76 - 1984/85
Million US Dollar

	Exports (1)	Imports (2)	% (1) / (2)
75/76	550.7	1062.1	51.8
76/77	594.8	985.8	60.4
77/78	551.2	1187.9	46.4
78/79	526.9	1115.8	47.2
79/80	594.0	1339.1	44.4
80/81	537.5	1540.2	34.9
81/82	432.0	1754.2	24.6
82/83	572.9	1534.4	37.3
83/84	707.0	1369.1	51.6
84/85	544.0	1237.2	44.0

The unsatisfactory performance of agricultural exports reflect the influences of a number of internal as well as external factors. On the internal side, the fluctuation of agricultural production, inappropriate producer price policies and lack of clear and consistent marketing policies were among the major factors that tended to discourage expansion in the production of the major export crops. Thus there was slow growth, and instability was created in the export volume. On the external side, deteriorating terms of trade and growing competition from other sources and from synthetics worked to generate problems for Sudanese exports.

Concerning generation of employment for the rural population, expansion of the agricultural sector, particularly during the sixties and the seventies, created many rural employment opportunities. Increasing numbers of nomads were settled in schemes such as Rahad, El Suki and New Halfa. They were provided with tenancies where they become active producers of cotton, wheat, sorghum and groundnuts. At the same time, the annual seasonal migration flow for employment in agricultural operations exceeds one million workers. These flows are mainly from the surplus labor areas of western Sudan to the irrigated and mechanized rainfed areas in the central and eastern parts of the country. However, most of the agricultural labor force are under-employed, and this creates a number of social and economic problems, including income instability. Solutions to this type of problem are currently being considered, including creation of additional sources of employment such as cottage and home-industries. However, long-term solutions to the problem of underemployment in agriculture will only be achieved through a structural transformation based on a shift to intensive, multiple-cropping agriculture producing for both the local and export markets.

Agriculture also contributes to the creation of urban employment indirectly, since employment in other sectors of the economy, such as food processing industries, textile, domestic and foreign trade in agricultural crops and the transport sector, is heavily dependent on the size and volume of the agricultural production.

The fourth objective of agricultural development plans has been to realize equal distribution of wealth between the various regions of the country. This has been a central objective, as it has been a prerequisite to secure social justice and to maintaining peace and stability.

During the era before the seventies, development plans tended to focus on the clay plains of the central and eastern regions where major irrigated and mechanized farming schemes were established. This approach has been justified by the availability of sufficient water resources, adequacy of essential logistics necessary for the technical and economic viability of the schemes, and accessability of these regions to the major markets.

Over time, this unbalanced approach to economic development brought social dissatisfaction and political unrest in other parts of the country, with the result that the country went through a period of political and social instability which tended to impede its overall economic development progress.

A new development philosophy, based on balanced economic growth for all regions, started to take place during the seventies. The five-year plan (1970/71 - 1974/75) and the subsequent development plans reflected this new philosophy as it focused on the development of the traditional sub-sector, which has been the main sub-sector in the less-developed regions. The effort to develop the traditional sub-sector was reflected in the implementation of a number of integrated rural development projects that tended to provide packages of programs and services to the traditional farmers, such as provision of essential inputs and improving marketing facilities. This new approach is now well institutionalized in the formulation of development plans, which assures its continuation in the future.

The fifth objective of agricultural development plans has been the maintenance, conservation and improvement of natural resources. These plans acknowledged that deterioration of natural resources, soil degradation and desertification problems are not only attributable to drought incidents and climatic factors but also to general land misuse.

Hence plans for natural resource conservation and development tended to emphasize the principal notion that land use be based on its actual capabilities. Realization of this required the availability of up-to-date resource-base maps involving detailed land capability classification which can be used for the formulation of a national land-use plan for agricultural development. FAO/GOS teams are currently working on the production of these maps.

A Supreme Council for Natural Resources has been set up and entrusted with the role of overall policy formulation for natural resources and their appropriate utilization.

B. Export/Import Structure and Goals

As outlined above, one major objective of development plans has been to promote exports as the principal source of foreign exchange, which is needed to meet the cost of imported capital, intermediate and consumer goods.

Cotton is the leading export crop, and during 1980/81 it contributed about 34% of the total value of exports. Other major exports included gum-arabic (6.3%), sesame (6.3%), groundnuts (12.3%) and livestock, mainly sheep, 17.6% (Table 3.6).

The marketing arrangements of these commodities are variable. The Sudan Cotton Company, which is wholly owned by the Government, has the monopoly for the export of cotton. The Sudan Oilseeds Company and the Gum Arabic Company, both being joint-venture companies with the Government owing 51% of the shares, and the private sector 49%, manage the export of oilseeds and gum arabic, although the initial marketing of these crops may take place through a variety of traders.

There is a variety of taxes on export crops. At the local level the usher tax, which is equivalent to an export tax, ranges between 10-15% of the value of the crop, and is paid by the buyer. Taxes at the export level include export duties levied at ad-valorem rates and development tax at 5% of the export value.

On the import side, the composition is more diversified and has tended to grow much faster than exports. During (1980/81-84/85) total average imports value amounted to $1487 annually, of which intermediate goods, including fertilizer, insecticides, crude material and manufactured goods represented 23%, petroleum 23%, capital goods, including machinery and transport equipment 22.8%, food and beverages, mainly wheat and wheat flour 20%, and consumer goods 6.3%. As mentioned above, the Sudan's own capacity for imports, which is determined both by the quantity of exports and terms of international trade, declined over the years. As a result, imports have been subject to different systems of controls. Essentials, such as crude petroleum, agricultural inputs and public-sector medical and pharmceutical products are imported at the official exchange rate, while other goods, such as spare parts and petroleum products, are imported at the more expensive commercial rate.

To economize on the use of foreign exchange, the country has in recent years turned increasingly to bilateral counter-trade agreements. It now has such agreements with Egypt, Saudi Arabia, Turkey and a number of other countries.

Table 3.5: Imports of Pricipal Agricultural Commodities: 1980-81 - 1984-85
Volume: '000 M.T unless indicated - Value: Million U.S. Dollars

	1980-81		1981-82		1982-83		1983-84		1984-85	
	1000 T	$	1000 T	$	1000 T	$	1000 T	$	1000 T	$
Wheat	59.9	13.2	286.6	67.9	211.8	40.1	219.8	75.6	97.0	87.0
Wheat Flour	99.0	30.4	181.0	59.7	153.3	31.6	118.9	41.8	192.0	37.9
Sugar	187.7	183.6	201.6	158.4	137.0	53.3	78.3	21.5	44.0	16.4
Other Foods	56.5	87.3	58.5	85.2	123.1	128.6	49.3	62.6	87.0	101.8
Beverage & Tobacco		23.1		23.6		23.8		23.7		9.3
Medicine & Pharmaceutical		32.8		20.0		39.6		33.3		26.7
Textile Fabrics	3.3	9.6	5.1	17.0	6.0	14.3	4.2	9.9	2.0	10.3
Passenger Cars (1)	1.9	13.4	9.4	67.9	8.1	32.7	3.5	23.4	3.0	18.4
Other Consumer Goods		20.2		24.9		23.7		14.9		19.1
Fertilizer	41.2	11.9	34.7	20.0	19.3	30.8	76.5	29.0	64.0	71.3
Insecticide	9.5	29.2	20.4	33.7	9.4	51.6	9.9	54.0	14.0	63.8
Juted Sacks ('000)	522.0	37.4	272.1	16.1	104.5	27.1	50.1	15.7	16.3	5.1
Metals Manufacture	96.8	114.4	96.5	134.1	115.4	125.6	148.5	119.5	101.0	106.5
Other Manufacturing Goods	97.4	96.2	81.0	87.5	80.4	50.8	244.7	70.7	85.0	58.6
Miscellaneous Chemicals		45.4		35.1		34.4		37.8		25.4
Other International Goods		123.0		102.0		84.4		85.2		38.9
Transport Equipment Machinery	28.4	111.4	26.5	86.4	30.4	116.1	31.2	106.6	37.0	81.4
Machinery Spare Parts	20.7	91.6	22.1	95.8	14.9	78.9	11.9	59.2	11.0	45.2
Tractors (1)	1.0	13.2	2.3	33.0	3.1	27.8	0.8	11.2	2.0	8.6
Miscellaneous Machinery		14.9		57.9		40.5		10.8		8.2
Transport Equipment	-	126.8		159.2		134.2		106.0		69.4
Petroleum	1546.3	311.2	1152.1	368.8	1142.2	344.4	1166.5	356.7	531.0	327.9
Total Imports		1540.2		1754.2		1534.4		1369.1		1237.2

(1) No. thousands.

Table 3.6: Exports of Pricipal Agricultural Commodities: 1980-81 - 1984-85
Volume: '000 M.T unless indicated - Value: Million U.S. Dollars

	1980-81 1000 T	1980-81 $	1981-82 1000 T	1981-82 $	1982-83 1000 T	1982-83 $	1983-84 1000 T	1983-84 $	1984-85 1000 T	1984-85 $
Cotton (1000 bales)	466.0	182.1	260.0	69.3	691.0	174.6	1198.0	333.3	846.0	244.4
Gum Arabic	25.5	34.3	31.3	43.2	34.6	47.5	46.9	63.5	35.1	41.4
Sesame	45.1	34.3	63.6	41.8	66.4	50.6	77.2	63.7	51.7	39.1
Groundnuts	69.9	66.2	118.3	48.1	23.0	16.7	18.8	15.4	15.3	6.7
Sorghum	320.4	69.8	260.0	64.5	381.2	87.4	180.7	31.1	-	-
Millet	1.6	0.2	2.5	0.5	7.8	2.4	1.5	.3	1.9	0.4
Senna Pods Kazkode	3.6	3.2	3.6	3.1	4.2	3.4	6.5	4.9	2.8	2.9
Other Agriculture	8.7	1.5	7.5	3.7	4.0	2.1	16.6	5.7	4.9	2.2
Sheep (head)	410.0	81.6	480.0	95.6	607.5	117.1	517.1	108.9	464.5	120.0
Cattle (head)	9.8	2.9	10.4	3.5	7.7	2.7	11.8	7.0	10.8	6.2
Camels (head)	.6	.2	1.0	.4	0.8	0.3	0.5	0.2	4.7	16.2
Goats (head)	2.2	.1	8.3	.2	7.7	0.3	7.0	0.3	4.2	0.2
Hides & Skins	4.1	9.8	6.4	7.4	8.0	10.8	14.0	12.3	12.7	11.1
Seeds (1)	26.3	6.3	33.2	11.9	37.4	15.2	19.6	9.8	12.4	7.1
Veg. Oils	32.9	11.8	18.6	10.5	13.9	9.7	18.5	16.6	21.0	5.2
Cake & Meal	146.0	23.0	105.7	15.8	90.7	15.5	95.8	16.6	75.5	1.6
Other Exports	23.6	10.3	9.4	12.5	21.0	16.6	19.3	17.4	23.8	39.2
Total Exports		537.6		432.0		572.9		707.0		543.9

...melon seeds.

Table 3.7: Value of Imports: 1980/81 - 84/85
(Million US Dollars)

	1980/81	1981/82	1982/83	1983/84	1984/85	AVERAGE	%
Food	314.5	371.2	253.6	201.5	243.1	276.78	18.61
Beverages	23.1	23.6	23.8	23.7	9.3	20.7	1.39
Consumer Goods	76.0	129.8	110.3	81.5	74.5	94.42	6.35
Petroleum	311.2	368.8	344.4	356.7	327.9	341.8	22.98
Intermediate Goods	457.5	428.5	404.7	411.9	369.6	414.44	27.87
Machinery	231.1	273.1	263.3	187.8	143.4	219.74	14.78
Transport	126.8	159.2	134.2	106.0	69.4	119.12	8.01
Total Exports	1540.2	1754.2	1534.4	1369.1	1237.2	1487.00	100.0

C. Structure of Prices and Subsidies

The policy for pricing of agricultural commodities is fragmented within the Ministries of Agriculture, Commerce, and Finance and Economic Planning. However, coordination is maintained between these ministries through technical committees which formulate and recommend the appropriate producer prices for the principal crops. The final approval of the recommended prices rests in the Ministerial Economic Committee chaired by the Prime Minister and including the Ministers of Agriculture, Commerce, Finance and Economic Planning, Industry, Energy and Transport, and Communication.

The producer price of seed cotton varies with the type of cotton. For each type the price set is a function of the world price, production costs and the marketing strategy of the Sudan Cotton Company, which has a monopoly on cotton exports.

The producer price of oilseeds (groundnuts and sesame) is also a function of the world price, production costs and marketing strategy of the semi-public Sudan Oil-seeds Company. These prices vary by grade and also by region to allow for differences in transport costs.

The Gum-Arabic Company submits its recommendations on producer prices to the Ministry of Commerce.

For oilseeds and gum-arabic, the prices set in this way are considered to be floor prices (or minimum prices), which theoretically implies that the concerned Government agency intervenes in case the market price falls below the floor price. Private traders who buy from the farmer at or above the floor price are obliged to sell to the relevant marketing monopoly at prices sufficient to cover their transaction costs and profit margin.

Two short-comings are noted here:

a) The producers of groundnuts, sesame and gum-arabic actually may not get the floor price. Numerous traditional farmers scattered over large areas (and given the weak market information system) may not have the facilities to go to the main market centers where they can get the floor price for their crops.

b) The timing of price decisions is not appropriate. If these price-setting exercises are to influence production, they have to be announced in advance of the sowing season. In fact, the prices are generally announced near harvest time. As a result, their influence has probably been minimal.

Subsidies

Agricultural producers are provided with a range of indirect subsidies on inputs and services provided to them. The principal production inputs of petroleum, insecticides, fertilizer and machinery are imported at the official exchange rate which is lower than the commercial and market rates, thus implying an indirect subsidy on these inputs. Costs of services provided by the Government, such as water rates, in the public agricultural corporations and interest rates on loans provided by the Agricultural Bank of Sudan, do not reflect the actual costs of these services, and therefore include hidden subsidies to their users.

On the consumer side, the prices of bread and sugar are directly subsidized, as their selling price is below their actual cost of production. The Government resorts from time to time to setting consumer prices of some other commodities, either on a country-wide basis, as in the case of sugar, or on a localized basis for meat, fruits and vegetables. Experience has shown that such fixed prices are easy to implement where Government has a monopoly on the supply, as in the case of sugar. However, in the case of meat, fruits and vegetables, where market supplies originate from thousands of small producers and are channelled through a small number of middlemen, the Government setting of prices assists merchants who use it as a pretext to offer lower prices to producers. The consumers often have to go without the particular commodity or to be content with sub-standard quality. Furthermore, if the price fixed by the Government for a particular product is not commensurate with its cost of production, the producer will tend to shift to the production of other products or smuggling. In the latter case a black market for the commodity will develop, with the consumer being the main loser.

A listing of producer subsidies is attached (Table 3.8).

Table 3.8: Subsidies Applicable to Principal Crops

A. PRODUCER SUBSIDIES

1. SUBSIDIES ON INPUTS (1)

Commodity	Seeds	Fertilizers	Pesticides	Machinery	Petroleum fuel	Others (specify)
Wheat		X		X	X X	Herbicides
Barley						
Sorghum		X		X	X X	Herbicides
Maize						
Rice						
Cotton	X			X	X X	Herbicides
Sugar beet						
Sugarcane				X	X X	Herbicides
Groundnut					X X	
Forage						
Legumes						
Food						
Legumes						

1) There is no direct sudsidy on these inputs but there is an implicit foreign exchange subsidy: imported at below the equilibrium.

2. CASH LOANS AND LOANS BY INPUTS

Commodity	Cash loan	Seeds	Fertilizer	Pesticides	Machinery	Others (specify)
Wheat						
Barley						
Sorghum (2)	X					X
Maize						
Rice						
Cotton	X	X X	X	X	X	X
Sugar beet						
Sugarcane						
Groundnut						
Forage legumes						
Food legumes						

2) Loans provided by Agricultural Bank of Sudan, mainly to mechanized farmers.

Table 3.9: Product Price Policies

A. Government Intervention Policies

Commodity	Above world prices	Below world prices	Free market prices
Wheat	X		
Barley			
Sorghum	X		
Maize			X
Rice			X
Cotton		X	
Sugarbeet			
Sugarcane			X
Groundnut		X	
Forage legumes			X
Food legumes			X

B. Consumer Subsidies

Food Commodity	Subsidized	Not Subsidized
Bread and flour	X	
Rice		X
Sugar	X	
Vegetable oil		X
Red meat		X

D. Plans for Institutional Development

The agricultural sector is served by three ministries: the Ministry of Agriculture and Natural Resources is responsible for the development and implementation of agricultural policies and programs for the crop sub-sector; the Ministry of Animal Resources is responsible for the development and implementation of policies and programs for the livestock sub-sector; and the Ministry of Irrigation is responsible for the control, regulation and development of surface-water resources.

The Ministry of Agriculture supervises several production units, the agricultural production corporations, and a number of service administrations, including Agricultural Extension, Plant Protection, National Seed Administration, Horticulture, Soil Survey and Agricultural Engineering.

D.1 Agricultural Extension Service

In general, the extension service is mainly confined to veterinary health and crop production, with some rare extension work in range management, forestry and animal production.

The extension service department of the Ministry of Agriculture is fragmented, with separate programs in the agricultural corporations and separate units in the administrative units of the regional government. In the agricultural corporation, extension work is implemented as a low-priority activity by the field inspectors. In the traditional rainfed and irrigated areas, extension activities are the responsibility of the regional extension service. The role of the National Extension Administration so far is confined to providing advice and support to the regional units, with almost no connection with the extension activities in the agricultural corporations.

In general, efforts of Agricultural Extension are confined to a small number of farmers, and hence its impact is limited. Among the reasons for this situation is the lack of funds, transport and trained manpower. Inadequate linkage with agricultural research is another reason for the unsatisfactory performance of the extension service.

Improvement in the services provided by Agricultural Extension will require concerted efforts to overcome its current problems. Establishing a two-way linkage between research and extension is vital for such improvement, but the success of such linkages will depend on the development of applied research, focusing on the problems of farmers under the actual on-farm conditions. Also, provision of sufficient funds and adequate transport will provide extension staff with capability for movement and contacts with farmers in their villages.

D.2 Training

Training in the field of agriculture is being provided by universities, polytechnic institutes and high-schools of agriculture.

The Universities of Khartoum, Gezira and Juba provide undergraduate education and graduate training in different disciplines of agriculture, veterinary sciences and natural resources, with the latter two universities more oriented toward addressing local community problems.

Polytechnic institutes focus on the practical aspects of agricultural education, with the two Institutes of Shambat and Abu Haraz focusing on irrigated agriculture and the one at Abu Naama focusing on rainfed farming. Other polytechnic institutes focus on veterinary and animal production training.

On the average, these institutes graduate more than 700 students annually (about 60 M.Sc. and 330 Diploma). In addition, a number of other B.Sc. holders graduate from foreign universities.

The needs of the country for trained personnel in agriculture are expected to grow as the structure of the sector changes in the next few years towards more intensive systems of farming. The quality of agricultural education also needs to be improved by strengthening field studies, particularly in the areas of economics, farm management and extension, by updating school and college curricula using locally generated data and information, and by training agricultural teachers. There will also be a continuous need for in-service training in the different fields of agriculture to update the qualifications of the already-employed personnel, both at the senior and middle level. This in-service training is essential if this staff is to efficiently respond to the needs of its various localities. In this regard, the capacities of the University of Gezira are currently being developed to plan and conduct systematic in-service training programs. It is hoped that this capacity could also be developed for other agricultural institutions so that they could meet the increasing needs of field staff for practical on-the-job training.

D.3 Marketing Institutions

As mentioned above, marketing arrangements are highly variable for the various agricultural commodities. At one extreme, marketing of cotton is handled by the Sudan Cotton Company, which is a public entity; at the other extreme, some food crops like millet, and to some extent sorghum, are handled entirely by private marketing arrangements, with virtually no state participation. In between are several major crops such as groundnuts, sesame and Gum Arabic, the marketing of which involves the traditional trading sector, the provincial governments, and export monopolies at various stages.

There are three levels of marketing for agricultural crops:

1. The primary markets, found in almost all the small towns in the crop-producing areas of the Sudan, perform three main functions-

    a) supply the consumers with essential commodities and household necessities;

    b) purchase and bulk cash crops for sale at the next level;

    c) trade in livestock.

    Most of these small markets operate for 5-6 months during and following the harvest. Crops are purchased mainly by merchant agents or by independent middlemen, who resell to larger merchants.

2. The secondary markets are at the district and provincial levels, such as Nyala, Elobeid and Gedaref, where auction markets for major crops are found. These markets are an important link between the strictly rural world of the primary markets and the commercial world of Khartoum and Port Sudan. In these markets cash crops are graded, weighed and sold by auction to the highest bidder.

3. Wholesale trade for the internal markets is mainly in the hands of private traders and companies, while export trade of the major agricultural commodities is dominated by public and semi-public companies.

In general, domestic markets have been highly responsive to world price trends, although they are not perfectly integrated. The lack of market integration results from inadequacies in market information, transport bottlenecks, insufficient storage facilities and shortage of the capital necessary for lubricating the system. The lack of good roads is a serious constraint on transport from the rural markets to the larger auction markets and, at the same time, contributes to the high freight rates from the major auction markets to the export outlet. In some places traders have, at least in theory, a choice between the railways and road transport; however, the unreliability of the former has put greater pressure on the road transport, which has had some improvement in asphalt roads in the last few years. Current efforts are directed towards improving the transport network, including both feeder roads and major roads, between the country's main port and agriculture and industrial activities across the country. The efforts also include improving the efficiency of the railways and better use of river transport.

D.4 Storage Services

These are provided by various agencies. Local traders sometimes provide storage services at the small rural markets. At the secondary level there are various suppliers of storage space, including railways which have some warehouses at major stations, regional authorities which have warehouses attached to their markets, and private warehouses. In addition, some of the public corporations involved in the wholesale and export trade, notably the Sudan Oilseeds Company and the Sudan Cotton Company, as well as the Agricultural Bank of Sudan, have storage space at different points in the marketing system.

In general, it is thought that the existing storage facilities are not sufficient and those existing do not meet modern standards. Therefore, there is urgent need for additional storage capacity, distributed over the major production and consumption centers. Construction of these facilities could be achieved either by providing credit to individual farmers or groups to build relatively simple, scientifically constructed storage facilities at the farm or village level, or by direct construction of storage facilities by the Government and/or public entities in the major assembly market centers and production areas for use by farmers, cooperatives, companies and public corporations.

D.5 Seed Supply

The National Seed Administration (NSA) of the MANR is given the responsibility for producing certified crop seeds, other than cotton, for the country. Breeder seeds are provided by the ARC from its stations at Wad Medani, Senner, New Halfa and Hudeiba. Production and distribution of cotton seeds is done by ARC in conjunction with the Sudan Gezira Board and other public corporations. Five stations have been set up for seed multiplication at Senner, Tozi, Samsam, New Halfa and Hudeiba. These stations multiply and supply seeds of wheat, groundnuts, sorghum, sesame, vegetable seeds and forage seeds.

The total area sown to various seeds and their production for 1986/87 season is shown on Table 3.10. This table also gives recommended seed rate and thus the area that could be provided with improved seeds. The final column reflects the percentage of total cropped area in production that could be provided with improved seeds.

It should be noted that present production of improved seeds is insignificant compared to the total requirements. Also, there is no seed production in any of the main traditional area of the western provinces,

Table 3.10: Production of Improved Seeds and Percentages of Total Cropped Area that could be Provided with Improved Seeds - 1986/87

1 CROP	2 AREA SOWN (FED.)	3 PRODUCTION OF IMPROVED SEEDS (TONS)	4 ESTIMATED SEED RATE PER FED. (KG)	5 POTENTIAL FOR AREA PLANTED (FED.)	6 TOTAL AREA IN PRODUCTION 86/87	7 % (5/6)
Wheat	1450	1120	55	20,364	278,000	7.3
Groundnuts	1120	850	37.5	22,667	1,181,000	1.9
Sesame	520	66	4.5	14,667	2,612,000	0.6
Millet	22	6.4	4.5	1,422	3,767,000	0.04
Sorghum	2650	1542	4	385,500	11,810,000	3.3
Vegetable	340	18	12.5	1,440	250,000	0.6

although efforts have been made to supply these areas with seeds produced in other parts of the country. Studies are under way to establish seed production farms in Kordofan and Darfour.

In general, access to improved seeds by farmers not related to the agricultural corporations is presently limited. This is the result of:

a) non-availability of seeds in certain areas;

b) lack of information on the part of the farmers;

c) absence of an appropriate mechanism whereby farmers would be motivated to substitute improved seeds for their own seeds on favorable terms.

The Sudan seed project intends to assist the country to overcome these problems. The project includes funds to strengthen the existing seed multiplication stations and to construct new ones with the aim to increase the capacity of the NSA in the production and distribution of improved seeds to meet the increasing needs of the country. But realization of these objectives will require that strong formal links be developed between NSA and the National Extension Administration and also between NSA and ARC, so that flow of information on seeds from and to farmers could be facilitated. A system also needs to be developed to facilitate the access of farmers to quality seeds at minimum costs to them.

Table 3.11: Imports of Pricipal Agricultural Inputs: 1980-81 - 1984-85
Volume: '000 M.T unless indicated - Value: Million U.S. Dollars

	1980-81		1981-82		1982-83		1983-84		1984-85		AVERAGE	
	1000 T	$	1000 T	$	1000 T	$	1000 T	$	1000 T	$	1000 T	$
Fertilizer	41.2	11.9	34.7	20.0	19.3	30.8	76.5	29.0	64.0	71.3	47.14	32.6
Insecticides	9.5	29.2	20.4	33.7	9.4	51.6	9.9	54.0	14.0	63.8	12.44	46.46
Jute and Sacks (1)	522.0	37.4	272.1	16.1	104.5	27.1	50.1	15.7	16.3	5.1	193.0	20.28
Tractors (2)	1.0	13.2	2.3	33.0	3.1	27.8	0.8	11.2	2.0	8.6	1.84	18.76

(1) Thousands
(2) No. Thousands

E. Importation and Local Production of Agricultural Inputs

Principal inputs used in Sudanese agriculture include fertilizer, insecticides, machinery and equipment, jute sacks and petroleum products. These inputs are imported, and their average annual value during 1980/81 - 84/85 amounted to $118.1 million, (Table 3.11).

Most imported fertilizer is used in the irrigated sub-sector, mainly in the public corporations and mostly on cotton, but also on wheat, fruit trees, and vegetables. Use of fertilizer is confined to nitrogenous types, principally urea, since nitrogen is considered to be the principal deficient nutrient in Sudanese soil. Use of phosphorus is increasing, as research results have proved increasing yield of wheat, sorghum and millet with the use of triple superphosphate.

Details of the type and amount of fertilizer used are exhibited in Table 3.12.

Table 3.12: Fertilizer Consumption (000 t) 1984

Type of Fertilizer	Consumption
Nitrogen (N)	86.00
Phosphorus (P205)	0.90
Potassium (K20)	0.04

The vast majority of all insecticide imports are used on irrigated cotton, with the cost of insecticides amounting to 40% of its total production costs. Insecticides are also used by individual farmers on wheat, fruit trees and vegetables. The Plant Protection Department also accounts for some of the total volume of insecticides used in the country since they have the responsibility for the control of natural pests. They also provide some services, at cost, to small farmers.

Farm machinery and implements used in the Sudan include tractors, land preparation equipment such as ridgers, cultivators, disc ploughs, disc harrows, chisel ploughs, combine harvesters and groundnut harvesters and decorticators. The stock of these items is listed in Table 3.13. Most of this equipment is used in the modern irrigated and mechanized rainfed subsectors. The Agricultural Bank of Sudan (ABS) provides loans in cash and kind for tractors and associated implements, mainly for mechanized rainfed farmers. Loans are also provided for small farmers and cooperatives in the schemes outside of the major agricultural corporations. However, the majority of individual farmers either have no access to machinery services or depend on hire-services, which poses problems of untimely agricultural operations as well as high renting costs. Problems of lack of spare parts, and inadequate repair and maintenance continue to be a serious source of dissatisfaction and an impediment to further development of agricultural mechanization.

Table 3.13: Stock of Agricultural Machinery 1985

Implement	Total	No./1,000 ha cultivable land
Tractors	18,510	2 Tractors
Harvesters (combined & treshers)	1,688	0.20 units
Sprayers & dusters	-	-
Ploughs	3,454	0.40
Cultivators	-	
Tillers	-	-

Source: Onur Osnam Zein El Abdein, Demand and Supply of Farm Equipment Unpublished paper, ABS Sudan 1985.

Except for traditional tools which are manufactured locally, no serious efforts have been made to manufacture imported inputs. A sack factory was opened some years ago at Abu Naama, some 400 kilometers south of Khartoum, based on kenaf production under irrigation from the Blue Nile. The factory was run by the public sector, and its performance came out to be poor and economical. At present, the factory is not operating, and negotiation is under way to hand it over to some private investors.

Efforts were also made to establish a domestic industry for fertilizer, but lack of crude materials made this venture impossible.

In general, there is a growing concern for the need to establish local production facilities for some important inputs, at least to save on foreign exchange. This is within the framework of Arab Economic Integration policies. The location of the different input industries has to be based on the availability of raw materials and the basic ingredients necessary for the manufacturing. For Sudan, manufacturing of agricultural machinery and implements is thought to be appropriate. This could start with the assembly, preparation for delivery of various equipment and machinery, and manufacturing of spare parts. The private sector could play a leading role in these ventures once provided with sufficient incentives and appropriate investment climate.

F. Development Projects

The current agricultural development plan is composed of a number of development projects designed to contribute directly or indirectly to the achievement of the national plan objectives. These projects are classified under the following categories:

F.1 Rehabilitation of Agricultural Corporations

The rehabilitation program for the agricultural corporations intends to improve and modernize the operation of the existing schemes with the objective of bringing them to their full operating capacity in the production of the major crops. The program includes provision of essential machinery and equipment, transport and communication facilities, building, staff training and management information system, together with the rehabilitation of the irrigation network and provision of social infrastructure in terms of health care, improved rural water supply, etc.

The total cost of the rehabilitation program for the 1986/87 fiscal year amounts to LS 114.2 million or 33% of the total agricultural development budget. A good part of the total rehabilitation cost is made available through credit from various regional and international institutions such as the Arab Fund for Economic and Social Development, the World Bank, EEC, IFAD, African Development Bank and USAID.

F.2 Integrated Rural Development Projects (IRDP)

These are designed to provide a package of services to the traditional small farmers. The IRDP usually includes provision of agricultural services of extension and plant protection, provision of inputs, including improved seeds, marketing facilities, including credit and storage, construction of feeder roads, adaptive research and provision of social infrastructure, including health care, drinking water and support for schools. Examples of IRDPs include western Savanna Development Project in the southern part of South Darfour, The Jebel Marra project, which serves the northwest part of South Darfour, the Nuba Mountain Rural Development Project in south Kordofan and the Blue Nile Integrated Rural Development Project, which serves the traditional farmers of south Blue Nile.

F.3 Agricultural Services Projects

The intent of this project is to improve and strengthen the services of extension, plant protection, horticulture, soil survey, the National Seed Administration and the Agricultural Engineering Administration. The administrations cover the entire country, although the extent of their operations is restricted by the limited resources available to them. From Table 3.14 it should be noted that the total funds available to these administrations accounts for only 4% of the total agricultural development budget.

F.4 Natural Resource Projects

These projects include forestry, pasture and range management, desert control and land-use management. The projects intend to conserve and improve the utilization of natural resources, introduce improved management methods, restore the vegetative cover in areas affected by desert encroachment, and to maintain the environmental balance.

Table 3.14: Development Projects by Categories: 1986 / 1987

Million Sudanese Pounds

	Location	1986/87 Local	Dev. Budget Foreign	Total	%
A. Rehabilitation Project :					
1. Gezirea	Central Region	16.3	57.8	74.1	
2. New Halfa	Eastern Region	4.5	10.8	15.3	
3. Blue Nile	Central Region	1.4	5.5	6.9	
4. White Nile	Central Region	1.5	5.1	6.6	
5. Northern	Northern Region	1.7	9.6	11.3	
Subtotal		25.4	88.8	114.2	33
B. Support for Other : Agric. Corporations					
1. Rahad	Eastern Region	2.5	1.9	4.4	
2. Suki	Central Region	0.9	-	.9	
3. Tokar	Eastern Region	2.3	-	2.3	
4. El Gash	Eastern Region	1.7	-	1.7	
5. Nuba Mountai	South Kordofan	1.0	-	1.0	
6. Mechan. Farming	Sudan	5.7	-	5.7	
Subtotal		14.1	1.9	16.0	4.6
C. Int. Rural Dev. Project					
1. W.S.D.P.	South Darfour	4.7	11.1	15.8	
2. J.M.R.D.P.	South Darfour	6.4	0.9	7.3	
3. N.M.R.D.P.	South Kordofan	2.5	1.1	3.6	
4. B.N.I.R.D.P.	Central Region	2.0	-	2.0	
Subtotal		15.6	13.1	28.7	8.3
D. Agric. Research Project					
	Sudan	11.6	9.8	21.4	
Subtotal	Sudan	11.6	9.8	21.4	6.2
E. Service Projects					
1. Extension	Sudan	-	-	-	
2. Plantprotection	Sudan	3.4	5.4	8.8	
3. National Seed Ad.	Sudan	1.6	2.9	4.5	
4. Horticulture	Sudan	0.3	-	0.3	
5. Soil Survey	Sudan	0.2	-	0.2	
Subtotal		5.5	8.3	13.8	4.0
F. Natural Resource Project					
1. Soil Conservation, land use	Sudan	2.2	-	2.2	
2. Forestry	Sudan	7.8	18.7	26.5	
3. Range Mgt.	Sudan	2.6	0.1	2.7	
4. Desert Control	Sudan	0.2	-	0.2	
Subtotal		12.8	18.8	31.6	9.1

Table 3.14 Continued:

Location	1986/87 Local	Dev. Budget Foreign	Total	%
G. Livestock Project				
1. A.P.R.A.	1.2	0.3	1.5	
2. V.R.A.	0.6	-	0.6	
3. Disease Control	1.9	2.0	3.9	
4. Vet. Ser. Adm.	2.3	-	2.3	
5. Fisheries Adm.	0.6	0.5	1.1	
6. A.P.P.C.	5.0	3.0	8.0	
7. LMMC	6.9	23.9	30.8	
Subtotal	18.5	29.7	48.2	13.9
H. Irrigation Projects	16.8	22.3	39.1	
Subtotal	16.8	22.3	39.1	11.3
I. Other Agric. Projects	15.5	17.7	33.2	
Subtotal	15.5	17.7	33.2	
GRAND TOTAL	135.8	210.4	346.2	100

One of the major features of these projects is to develop the Gum Arabic belt, which contributes both to the welfare of a number of the rural population and to generate foreign exchange.

F.5 Development Projects for the Livestock Sector

These account for approximately 14% of the total agricultural development budget and are distributed over the entire country. These projects include strengthening of animal and veterinary research, improvement of the capability of services provided to animal owners and provision of marketing services to promote movement of animals from production centers in the western and southern parts of the country to the major urban centers and export markets.

F.6 Irrigation Projects

These account for 11.3% of the total agricultural development budget and intend to improve and develop the irrigation infrastructure and networks and to promote research on improved irrigation methods.

G. Research for Agricultural Development

G.1 Research Institutions

Research for agricultural development is being undertaken by various institutions. The Agricultural Research Corporation (ARC) is the major institution in the country which has the responsibility for planning and implementing basic, applied and adaptive research, with a mission of producing maximum yields with minimum costs. Its research activities are focused mainly on crops, but also include research on forestry, range management, fisheries and marine biology and food processing research. ARC has its headquarters at Wad Medani, with five regional stations at Wad Medani, Yambio, Hudeiba, Abu Naama and Kadougli. A number of substations are distributed over the country with different specializations to deal with the different agro-ecological conditions. These are identified on Map 3.1.

Until very recently, crop research has been concentrated on the irrigated sub-sector, particularly on cotton. However, the efforts now have been expanded to include rainfed crops through the Western Sudan Agricultural Research Project, which has stations at Elobeid, Kadogli, El Fasher, and Nyala.

Some development projects, such as The Western Savanna Development Project, and Jebel Marra Rural Development Project, also undertake some type of adaptive research under the supervision and support of the ARC.

The colleges of agriculture at the Universities of Khartoum, Gezira and Juba and the polytechnics are also involved in agricultural research, although their work is oriented more towards basic research than applied and adaptive research.

The Agricultural Research Council of the National Council for Research assists with policy formulation, and organization and finance of multi-disciplinary teams to focus on specific research problems.

Livestock research is the responsibility of the Ministry of Animal Resources. There are two departments for research:

a) The Animal Production Research Administration is more concerned with cattle and sheep breeding, fattening and animal nutrition. It has five substations, at Shukkaba, Umbenin, El Huda, Gazala Gawazat and Atbara.

b) The Veterinary Research Administration has its main laboratories at Soba and is working mainly on animal health research and production of vaccines.

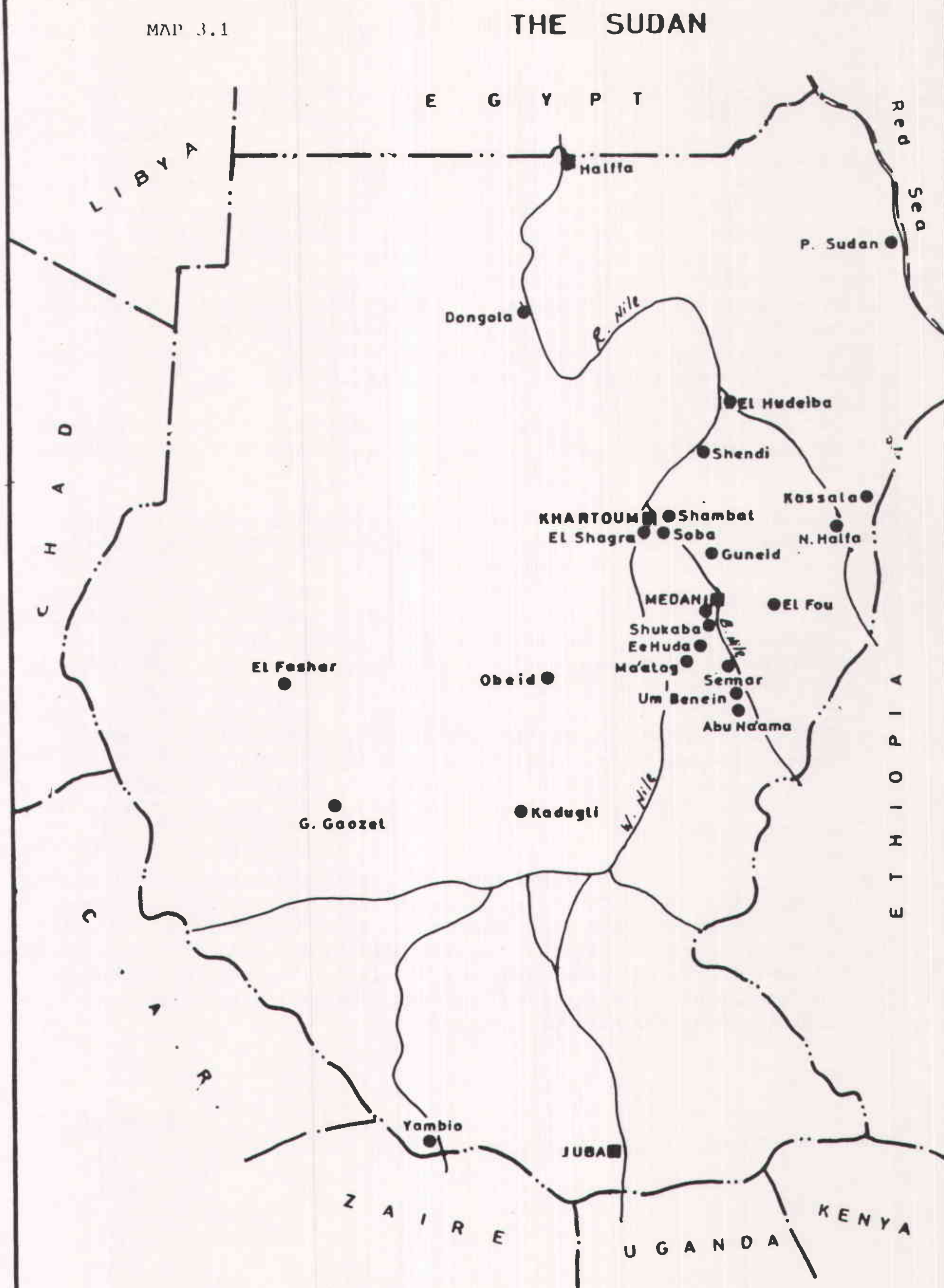
The College of Veterinary Science and the Institute of Animal Production at the University of Khartoum are also engaged in livestock research.

Social and economic research for agriculture occurs in different institutions. The Planning and Agricultural Economics Administration of the Ministry of Agriculture is undertaking research in the areas of production economics, marketing and agricultural policy analysis, together with the task of collecting, processing, analyzing, and disseminating agricultural statistics of the various crops.

The socioeconomic units of the major agricultural corporations, particularly of Gezira and Rahad, undertake surveys and economic studies for their respective institutions.

The departments of agricultural economics at the universities and the Development Studies and Research Center of the University of Khartoum are also engaged in economic research of agriculture.

MAP 3.1



LOCATION OF RESEARCH INSTITUTIONS AND EXPERIMENTAL FARMS

■ RESEARCH INSTITUTIONS

● EXPERIMENTAL FARMS

The Economic and Social Research Council of the NCR is another institution which is involved in economic research for agriculture.

G.2 Research Orientation

At present, efforts to improve agricultural technology and to intensify production are focusing on the problems of the modern irrigated subsector, with less emphasis and less concern for the problems of the rainfed sub-sector, particularly the traditional portion of it. Some efforts have been made, however, to rectify this situation, most notably through the Western Sudan Agricultural Research Project. But these efforts are still small-scale and are not proportionate to the size and scope of problems facing the traditional rainfed farming.

In general, further improvements in agricultural research are needed if it is to meet and respond to the needs and requirements for sustained economic growth:

a) Research institutions need to be strengthened in terms of trained manpower, sufficient funds, and other resources needed to undertake the various types of research.

b) Strong linkages between research and extension need to be established if research results and new production technologies are to be transferred to farmers and if research activities are to be based on the actual problems of farmers.

c) Coordination between the various units working on socioeconomic research needs to be institutionalized to direct their efforts in a coordinated and consistent way towards the problems of agriculture in the fields of production, marketing, processing and utilization of agricultural commodities.

d) It will be useful to establish an interdisciplinary body with the responsibility for planning, coordinating, and budgeting all research programs and manpower requirements and training. Such a body will work to direct the overall research efforts and available resources to address the principal problems of agriculture and to maintain coordination, consistency and relevance among the research activities undertaken by the various institutions.

Section 4

PERFORMANCE OF THE AGRICULTURAL SECTOR

In general, the performance of the Sudanese economy, including the agricultural sector, has not been satisfactory during the recent past. GDP per capita has been falling in recent years, reaching $375 in 1985 compared to $430 in 1982. Most sectors of the economy have not realized any significant development. Industry which is primarily based on processing of agricultural commodities remains undeveloped and is still facing serious problems. The development of an efficient transportation infrastructure, vital for sustained economic growth, is being impeded by lack of sufficient investment funds and also by the vastness of the country. All sectors of the economy are still suffering from energy shortages.

The performance of the agricultural sector has not been better than the general economy. Its GDP in real terms declined from LS 2450 million in 1977/78 to LS 2106 million in 1986/87 (Table 4.1). As a major source of foreign exchange, it failed to generate sufficient foreign currency to meet the import bill. The revenue-generating capacity of the major agricultural corporations declined, and they are becoming a financial burden on the national treasury. Production in the traditional sector worsened and output of its major crops (short-staple cotton, groundnuts, sesame, gum arabic) declined.

Several reasons could be cited to explain the poor performance of the overall economy and particularly of agriculture. Conflicting social and economic objectives and mismanagement and misallocation of the available resources is one reason. The misallocation of resources was reflected in the excessive emphasis on large-scale schemes and the neglect of small farmers. This approach overestimated the supply response of these schemes to increased investment and at the same time underestimated its requirements for foreign exchange. This approach reflected a misunderstanding of comparative advantage as the traditional farming and livestock sub-sectors were virtually excluded from development programs.

Second, management of development plans, in terms of monitoring and evaluation, was poor.

Third, the pricing and marketing policies were not conducive to increased production, since they did not reflect sufficient rewards for producers.

Finally, the worsening climatic conditions in the late seventies and early eighties, especially the drought years of 1982/83 - 1984/85, were also responsible for the poor performance of the agricultural sector in particular and for the failure of efforts to improve the overall economic situation in general.

Table 4.1: Total GDP, Agricultural GDP and Index of Real Agricultural GDP
Million Sudanese pounds, at 1981/82 prices

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Total GDP	6047	5396	5589	5671	6063	5785	5730	5329	5697	6356
Agricultural GDP	2450	2037	1903	1820	2067	1790	1703	1367	1899	2106
Index of Real Agricultural GDP	118	98	92	88	100	87	82	66	92	102
1981/82 = 100										

A. Crop Sub-Sector

Sudan is one of the few countries of the world that still presents vast scope for horizontal expansion in crop production. Currently about 8 million hectares out of a possible total of 61 million are used for cropping. As mentioned above, the country is almost self-sufficient in food, and given the necessary investment resources, has the potential to produce sizeable surpluses to contribute to the food security of the region.

The crop sub-sector contributes the major portion of the total agricultural GDP, amounting to 54.7% (1981/82 - 86/87).

The six-year plan 1977/78 - 1982/83 allocated a total of LS 325 million for the development of the crop sub-sector. This amount represented 45.4% of the LS 715 million allocated for the agricultural sector during the plan period. The objectives were to increase total output for the major crops to meet domestic demand and to create sufficient surplus for exports. The production targets, as shown in Table 4.3, were to be realized through vertical expansion, aiming at optimizing resource utilization and making the production of crops more competitive, and through horizontal expansion by bringing into production the vast untapped land resources.

Unfortunately, the targets set for the six-year plan have not been achieved. As shown in Table 4.3, for all the major crops total output during 1985/86 - 1986/87 was lower than the target for 1982/83. For cotton, total output in the last two years was 52% of the plan target; for sorghum, millet and wheat it was 91%, 68% and 27% respectively. For sesame it was 53% and for groundnuts 20%.

It should be noted from the table that in terms of area, except for sorghum and millet, area targets for other crops were not achieved. More striking is the poor performance of the yield: for all crops yield level during 1985/86 - 86 - 87 was much lower than what was targeted for 1982/83, the last year of the six-year plan, indicating that no major breakthrough in crop productivity has been achieved after the completion of the development plan.

The failure of the crop sub-sector to achieve its targets was part of the overall poor performance of the agricultural sector, which was caused by the overall weakness of the economy, deficient macroeconomic policies, misallocation of resources and the other factors which were outlined and discussed above. But more directly related causes for this failure would include insufficient funds for research and hence the paucity of improved farming technology which in economically and ecologically feasible, the weakness of the extension service and the absence of any formal and institutionalized linkages between research and extension, which weakened the transfer of appropriate technologies, as might be available to the farmers.

B. The Livestock Sub-Sector

Yield Performance of Livestock and Poultry

The Sudan has an enormous wealth of livestock and poultry consisting of cattle, sheep, goats, camels and chickens. The country is self sufficient with regard to red meat and broiler meat and is even exporting cattle, sheep and camels to neighboring Arab countries.

Sudan cattle are of the Zebu type, which are adapted to the tropical regions of the world. They are divided into northern and southern breeds. The northern Sudan breeds are either Kenana, Butana or Baggara and are characterized by their short horns. The names given to these breeds actually refer to areas where they are predominant (Butana) or to the tribes that own them (Kenana and Baggara). The three breeds are dual purpose, producing milk and meat at the same time. The Kenana and Butana breeds tend to produce reasonably high milk yield under good management. Average yield of Kenana is 1555 kg/year, while that of the Butana is 1095 kg/year. Such yields are fairly comparable to or higher than those of breeds from other Arab countries for the Shami breed of Syria. Meat yield is also reasonably high but lower than that of Tunisian local and the Shami breeds. Other breeds found in the northern Sudan are the Nubi and Um Barraro. The first is small in size and is only found in the Nuba Mountains, while the latter is a long-horned introduction from West Africa. The southern Sudan breeds are small-sized and long-horned. They are named after the tribes that own them, e.g., Dinka, Nueir and Shulluk. They are bred for meat production. In addition to local breeds, small numbers of crosses between Kenana or Butana and introduced Friesian breed are present. Such crosses are mainly bred for milk production and yields are generally quite high.

Sheep bred in the Sudan are long-tailed. They are divided into desert and Nilotic types. The desert sheep constitutes about 80% of the population and is the major source of meat in the country and is also exported. Desert sheep are named after the tribes, i.e., Shukri, Hamari, Kabashi and Zagawi. The Nilotic type present in the south is short-tailed and is called the Taposa breed.

Goats are mainly bred for milk and to some extent for meat production. The major breeds are Nubi, Desert, Nilotic and Swiss (introduction). The Swiss breed is large in size and a high milk yielder.

Sudanese camels descend from the single-humped Arabian type. They are used by nomads for milk production. Camel meat is not preferred by most Sudanese, and camels are therefore exported to Egypt. The important breeds are Rashaida, Bushari and Anafi.

Poultry is an expanding industry. Total population in 1985 was estimated to be 27 million birds. Local breeds and crosses with introduced ones constitute 80% of the population. The remaining 20% are introduced hybrids, such as white Leghorn and red Sussex. The production of poultry products is sufficient to satisfy local demands. In 1980 egg and broiler production was 19.5 and 17.7 thousand tons respectively.

The livestock sub-sector is the largest agricultural sub-sector in terms of its contribution to the sector's GDP, which amounts to 34%, Table 4.2. This relatively high contribution of the sub-sector does not, however, reflect its full potential, which could be realized from the sizable animal wealth of the country. The majority of livestock, composed of cattle, sheep, goats and camels, are held mainly under traditional nomadic patterns. Hence, livestock is not fully exploited commercially, as a large portion of it is held out of the economic mainstream primarily for subsistance and prestige purposes.

Table 4.2: Contribution of the Agricultural Sub-Sectors to Agricultural GDP, 1981/82 - 1986/87 in million Sudanese Pounds at 1981/82 prices

	1981/82		1982/83		1983/84		1984/85		1985/86		1986/87		Average	
	Value	%	Value	%	Value	%	Value	%	Value	%	Value	%	Value	%
Crop Sub-Sector														
Irrigated	523.9	21.8	652.7	29.4	673.7	31.1	714.0	40.8	686.0	32.9	748.0	33.8	666.2	31.2
Mechanized	319.1	13.3	153.2	6.9	155.5	7.2	64.0	3.7	285.0	13.7	331.0	15.0	218.0	10.2
Traditional	441.1	18.4	290.1	13.1	239.7	11.1	174.0	9.9	305.0	14.6	253.0	11.4	283.8	13.3
Sub Total	1284.1	53.5	1096.0	49.4	1068.9	49.4	952.0	54.4	1276.0	61.4	1332.0	60.2	1168.0	54.7
Livestock	814.7	33.9	822.8	37.1	787.0	36.4	624.0	35.7	625.0	30.0	691.0	31.2	727.4	34.0
Forestry, Fisheries & Agric. Services	300.1	12.6	298.7	13.5	307.8	14.2	173.0	9.9	183.0	8.8	191.0	8.6	242.3	11.3
Total Agric. GD	2401.9	100	2220.1	100	2164.2	100	1749.0	100	2084.0	100	2214.0	100	2137.7	100
Total GD For the Economy	6720.5		6765.4		6477.7		5384.0		5675.0		6076.0		6183.0	

During the six-year plan, a total of LS 163.4 million, representing 22.8% of the total investment funds allocated for agriculture, was allocated to the livestock sub-sector, consisting of LS 55.2 million for public-sector projects and programs and LS 108.2 million for private-sector projects. The main thrusts of these projects and programs were:

a) improving animal health by veterinary research, extension and disease control measures;

b) encouraging animal production by improving and expanding watering facilities in grazing areas, improving pastures and establishing stock-routes to facilitate marketing;

c) encouraging poultry production and milk production, by providing sufficient incentives to the private sector.

In general, implementation of the planned projects for the livestock sub-sector faced numerous problems, which affected the overall achievement of the plan targets:

First, the deficient macroeconomic policies and the frequent changes in these policies weakened the performance of the national economy in general, adversely affecting the investment climate and reducing the incentives for private sector active involvement in the development process (private sector share was about 66.2% of the total planned investment in the livestock sub-sector).

Second, total investment funds that were made available for the sub-sector were insufficient and did not meet its total needs. Many projects were either not started at all or not completed. Those completed were not able to operate at full capacity.

Problems of infrastructure continued to pose serious problems. Lack of marketing facilities and a proper transportation system to overcome the hazards of trekking animals through long distances, inadequate animal health services to combat diseases, shortages or below-standard slaughter houses and poorly equipped quarantines caused numerous problems and led to insufficient supply of animals for slaughtering and/or for exports.

Finally, changes in climatic conditions have also negatively affected the development of the livestock sub-sector. For example, the drought of 1982/83 through 1984/85 resulted in deterioration of pastures, serious shortages in water supply, and death of large numbers of animals.

C. Forestry

Forestry plays an important role in the Sudanese national economy. It supplies the country's requirements for building materials, furniture, round wood and poles for various industries and raw materials for the manufacturing of paper and pulpboards. The sub-sector supplies 82% of the country's energy requirements, in the form of woodfuel, thus saving a considerable amount of foreign exchange. Gum arabic is an important product of the forestry sub-sector. It is also an important export crop, the value of which was $ 63.5 million in 1983/84 and $ 41.4 million in 84/85.

The sub-sector provides direct employment for about 170,000 people (excluding self-collected fuel wood and poles).

Table 4.3: Crop Sub-Sector - Six-Year Plan Targets and Actual Production 1985/86 - 86/87 - average

	1982/83 Targets			1985/86 - 1986/87			Actual %(
	Area	Yield	Output	Area	Yield	Output	
Cotton	627	1477	926	342	1405	480	51.8
Sorghum	3822	978	3740	5184	656	3403	91.0
Wheat	374	1786	668	134	1328	178	26.6
Millet	1176	440	518	1639	214	351	67.8
Sesame	1134	330	378	1078	185	199	52.6
Groundnuts	1218	1287	1568	448	720	322	20.5
Sugarcane	121	250	30210				
Rice	42	1357	57				
Maize	132	909	120				
Coffee	6	1667	10				
Tobacco	3	533	1.6				
Broad Beans	23	2043	47				

(1) Actual output as percentage of this target.
Area : in Thousand Hectares.
Yield : in Kg per Hectare, except Sugar-cane : M.T./Hectare.
Output: in Thousand M.T.

Table 4.4: Livestock, Livestock Products, Fish and Poultry 1985

No = 1,000 Head.
Eggs = Million.
Production (Meat and Milk) = 1,000 T.
Fish = 1,000 T.

Animal	Total* No.	Production Meat**	Milk**	Eggs
Cattle	22,140	530	1384	X
Sheep	21,310	165	135	X
Goats	14,652	83	458	X
Poultry	27,600	30	X	600 (33,000 Tons (1984))
Camels	2,864	49	X	X
Fish	X	30	X	X

Source: * Total = F.A.O. Records, ** Meat & Milk Records

The six-year plan provided for 11 forestry projects in the public sector, costing a total of LS 9.4 million. The main objectives of these projects were to achieve conservation and protection of forestry, expand tree plantation and to establish industries based on forestry raw material. The plan targets are shown in the following Table 4.5.

Table 4.5: Forestry Sub-Sector - Six-Year Plan Targets

	Units	1982/83 Targets
Sawn timber	1000 M^3	38.2
Round Wood	1000 M^3	1422.0
Bamboo	1000 M^3	7.4
Poles	1000 M^3	9.1
Fire Wood	1000 M^3	22953.0
Charcoal	1000 Ton	805.0
Gum arabic	1000 Ton	62.0

D. Fisheries

The objectives of developing marine and inland fisheries were to increase the supply of white meat to meet the increasing domestic demand and to be in a position to direct a portion of the high-quality red meat to the export market.

The six-year development plan included projects for organizing fisheries cooperatives, to improve and increase the supply of services to fishermen, training of fishermen, supply of modern fishery gear and development of fish markets and facilities for processing of waste and other related products. The total investment allocated for these projects was LS 1.65 million.

By 1985 total fish production represented only 43% of the plan target, or 26,000 m.t., as compared to the 1982/83 planned production of 60,000 m.t. (Table 4.4).

E. Yield Performance of Major Crops

Grain sorghum (*Sorghum bicolor*) is the most important cereal food crop in the Sudan. The total area under sorghum averaged 4.0 million ha during 1983 - 1985 seasons, about 50% of the total cultivated area. Sorghum production, about 2.2 million tons annually, accounts for about 80% of the total cereal production. Sorghum grown under irrigation accounts for only 7% of the sorghum area but about 15% of grain production. The remainder of the production comes from rainfed areas. Rainfed sorghum production is further divided into the mechanized farming sector (62% of total crop) and the traditional sector (23% of total crop). The overall yield of sorghum (517 kg/ha) is low and below figures from developed countries (2100 kg/ha). Irrigated sorghum yields are about 1038 kg/ha, almost double that from mechanized rainfed cultivation (514 kg/ha). The traditional sector represents the poorest average yield/unit area (376 kg/ha). Sorghum varieties grown in the Sudan include Dabar 1, Gadam El Hamam, Dwarf White Milo, Hageen Dura I, Mayo, Fetaritas, Korakolo, Ras El Girid, Iriana, Um Benein 7, Um Benein 21 and Safra. The improved varieties are Dabar 1, Gadam El Hamam, Hageen Dura 1, Um Benein 7 and Um Benein 21. The remaining varieties are not improved but are grown by farmers in mechanized areas.

Wheat is grown under irrigation in the northern, central and eastern regions during the winter period (October - March). Winter in the Sudan is short and with relatively higher temperatures and lower humidity than in the traditional wheat-growing regions of the world. Wheat occupied about 145,000 ha in season 1981/82, and the average yield was about 1062 kg/ha. These yields are no doubt very low due to unfavorable climatic conditions, poor land preparation, inadequate supply of inputs and delayed sowing. The most important commercial varieties grown are Giza 155, Condor, Wadi El Nil Mexicani and Beladi.

Cotton is the main cash crop in the Sudan. It occupies 462,000 ha, and about 88% of it is produced under irrigation. The main varieties grown are Barakat 82, Shambat B, Barac (67) B and Albar. The first three varieties are grown under irrigation, but Albar is produced under rainfed conditions. Other varieties grown in small areas include VS82, Huda and Maryud. In the Gezira scheme yields ranged from 770 - 1640 kg/ha during the period 1977 - 1983. Rainfed cotton yields are much lower than this and range between 265 - 350 kg/ha.

Groundnut production in the Sudan has increased rapidly in the last decade. Substantial increases in the area planted (1.03 million ha) and marked improvements in yield have taken place. The Sudan has therefore become a major groundnut producer, now ranking fourth among producing countries. Most of the production (69%) is from irrigated areas such as Gezira, Rahad, New Halfa, White Nile, Blue Nile and Rubatab. The rest of the produce is from rainfed cultivation in North Kordofan and South Darfur. Average yields from irrigated areas are about 1.4 tons/ha while that from rainfed areas is about 1.2 tons/ha. The main varieties grown at present are Ashford, MH 383 (irrigated) and Barberton (rainfed). Only recently Kiriz and Sodari have been released for growing under irrigation and rainfed conditions respectively.

Sesame is exclusively produced under rainfed conditions in Kordofan, Kassala and Blue Nile provinces and occupies an area of 857,000 ha. At present four white-seeded varieties (Ziraa 1, Ziraa 3, Ziraa 6 and Ziraa 7) and two brown-seeded types (Huria 1 and Huria 31) are grown. The average yield (260 kg/ha) is considerably lower than that achieved in China, Afganistan, Ethiopia, Mexico and Venezuela.

Sugarcane is produced completely under irrigation by the Kenana, West Sennar, Asalaya, Guneid and New Halfa Sugar Companies. Improved high-yielding cultivars that are resistant to smut disease include CO.1001, CO.6808 and M33 - 45. Yields are generally low (60 - 95 tons/ha) in comparison with most sugarcane producing countries.

Millet is almost exclusively grown in the Western Sudan under rainfed conditions. Small areas are, however, planted in the flush-irrigated Tokar Delta. The total area is about 875,000 ha. Local varieties are usually grown, but recently Ugandi, which is an improved high-yielding cultivar, has been released. The average yield is low (720 kg/ha).

Broad beans are grown in the Northern Region under irrigation in 25,000 ha. Varieties include Baladi, Selaimi, Rebaya 34 and Rebaya 40. The average yield is about 1400 kg/ha.

Castor is grown in the Gash Delta in 12,600 ha. Varieties grown include Pacific 6 and Cimarron. Average yield is generally very low (700 kg/ha). Vegetables are gaining great importance in the Sudanese diet, and areas in the last decade have considerably expanded. The total area under vegetables is about 40,000 ha. A range of crops and varieties are grown. Yields are, however, generally low and are far below those of other Arab countries. Details of the 1985-86 area, yields and production of principal crops are provided in Table 4.6.

F. Seed Availability

Most of the farmers in the Sudan use uncertified seed. They usually select seed from their fields and plant them the next season. Certified seed are usually not available to the traditional rainfed subsector. Shortage of certified seed in the country is due to lack or shortage of facilities available to the National Seed Administration. Over the past few years, however, this administration has expanded with the help of a FAO/UNDP project. A start was made with the production and processing of certified seed of major crops. Productivity of the administration farms is generally low. The average production of seed is below 3,000 tons compared to a country-wide requirement of around 100,000 tons. The annual improved seed requirements for major crops are 36,750 tons of wheat, 12,900 tons of sorghum, 43,100 tons of groundnuts, 1700 tons of sesame, 2,430 tons of millet, 95 tons of Kenaf, 150 tons of castor, 1,800 tons of broad beans and 25 tons of alfalfa. In addition, vegetable seed importation is around 200 tons.

It is therefore evident that the National Seed Administration is inadequately equipped to provide the required improved seed to the farmer. In order to alleviate the problem large production schemes such as the Gezira, Rahad, New Halfa, Nuba Mountains and Mechanized Farming Corporation are producing cotton seeds needed for the whole Sudan. Furthermore, they have initiated the production of improved seed of wheat, sorghum and groundnuts for distribution to the farmers in their schemes. They lack sufficient seed-processing capacity and trained staff, however,.

Productivity of both livestock and poultry is generally low, and this is attributed to inadequate supply of good-quality feed and to the nomadic nature of livestock production.

Table 4.6: Area, Yield, and Production of Principal Crops of the Country in 1985-86 and 1991-92 Production Targets

Crop	Area 1,000 ha			Yield t/ha (1985-86)			1985-86 Production 1,000 t			1991-92 Production Target 1,000 t		
	I	M	T	I	M	T	I	M	T	I	M	T
Cotton Long staple (Seed cotton)	200	-	-	1.1	-	-	222	-	-	355		
Cotton Medium staple (Seed cotton)	112	-	-	1.6	-	-	178	-	-	475		
Groundnuts (Unshelled)	61	-	366	1.5	-	0.6	94	-	192	400		560
Sorghum (dura)	472	3586	1351	1.4	0.7	0.4	660	2328	536	300	2118	851
Millet	9	53	1672	0.7	0.4	0.2	7	22	388	-	-	650
Wheat	151	-	-	1.3	-	-	199	-	-	350	-	-
Sugarcane	48	-	-	81.8	-	-	414 (sugar)	-		7000		
					(Sugar cane)							
Sesame	-	495	563	-	0.1	0.1	-	58	76		170	172
Gum arabic	-	-		-	-		-	-	14			67
Legumes (Faba bean)	60	-	-	1.3			80			64		
Vegetables & Fruits	105											

I = Irrigated Farming M = Mechanized Farming T = Traditional Farming

Source: 1: Department of Agric. Econ. Mini of Agric. Monthly Report March
2: Gum Arabic Company (normally around 40 thousand)
3: Dept of Statistics, Mini of Agric & Forestry Administration
4: Ministry of Finance and Planning (Planning), Prospects, Programs and Policies for Economic Development Vol 111 1984-85) 86-87.

Part II

Functional Analysis

PART II

ANALYSIS OF STRUCTURE AND FUNCTIONAL ANALYSIS OF THE AGRICULTURAL TECHNOLOGY MANAGEMENT SYSTEM (ATMS) IN THE SUDAN

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PART II

ANALYSIS OF STRUCTURE AND FUNCTIONAL ANALYSIS OF THE ATMS IN THE SUDAN

A. Methodology

The methodology calls for the identification of prinicipal institutions and groups within the agricultural technology management system (ATMS) in the Sudan and an understanding of how those institutions and groups relate to one another. Particular attention is given to identifying institutions and groups which are found to have significantly affected structure and performance of the Sudanese agriculture.

The other two interrelated elements within the structure of ATMS in the analysis are the critical functions ATMS is expected to perform, and the mechanism by which the system carries out these functions. The functional analysis provides a methodology for describing an ATMS in terms of key functions and the role particular institutions and groups play with respect to each function. Since the ATMS is not consciously defined by most participants in it, the functional analysis provides a framework in which improvements can be systematically discussed. A function may be performed inadequately because there are too few, or too many, institutions and groups involved, or because the mechanisms applied require improvement.

The main instrument of analysis is a "linear responsibility chart". This is used to identify institutions, tasks, and responsibilities for execution.

Thirteen key functions are identified which an ATMS must perform, or at least influence. If the system carries out all 13 functions effectively and coherently, it is likely to be "successful". These key functions, and the analyses that must be undertaken, follow:

1. Define macro-economic strategy

Analyze the organizations involved in making basic macro-economic policies relating to rates of exchange, relative prices, and size of government which set the overall framework in which the agricultural sector operates. These policies have an impact on agricultural innovations.

2. Define intersectoral allocation of resources

Determine the share of the government's budget devoted to agriculture and the way in which that proportion is fixed. This is a measure of the importance attached to agricultural development and of the potential resource available for agricultural technology generation and transfer.

3. Develop human resources for the agricultural sector

Determine whether ATMS organizations are efficient in developing and managing their own human resources. Management of human resources involves the identification of needs, planning for human resources, the execution of training plans, and the establishment of conditions of service which attract and retain the human resources required by the system.

4. <u>Generate domestic political support for agricultural research</u>

Organizations need political support for their activities. Determine whether the ATMS organizations actively seek to generate support or detract from support for agricultural research through inaction or opposition.

5. <u>Generate external support for agricultural research</u>

Identify organizations which generate external support for agricultural research/extension, and the mechanisms they use. The external support an ATMS enjoys may be a crucial element in its success or failure.

6. <u>Set goals for the agricultural sector</u>

Clarify how goals are set for the agricultural sector. The establishment of realistic goals and the creation of appropriate mechanisms by which they are set are important functions for the success of the sector.

7. <u>Allocate resources within the agricultural sector</u>

The amount of resources devoted to research, extension, credit, input supply, and marketing guarantees is a decision variable affected by the political-bureaucratic structure. Analyze the mechanisms through which each organization influences those decisions.

8. <u>Determine agricultural research strategies (macro-level)</u>

The determination of research strategies involves the identification of development objectives, the expression of those objectives as research problems, and the choice of appropriate research strategies to solve those problems. Determine the role and effectiveness of each technology-generating organization in setting these strategies.

9. <u>Generate and assess technology</u>

Identify all organizations which generate and assess technology. Technology generation takes place primarily in national research institutes, but universities, private firms, and external organizations are also involved in generating and assessing technology.

10. <u>Transfer technology</u>

Identify and analyze institutions and mechanisms involved in technology transfer. Interfacing between research and extension is an important function of the ATMS. In the absence of an effective public extension service, other channels for the transfer of technology and for related information exchange may be identified.

11. Provide support service to technology adoption

Support service organizations in agriculture provide a range of services -- from seeds to credit and tractor hire. Identify the principal organizations and the services they provide. Note as well of support services provided by organizations not primarily part of the support service sector.

12. Evaluate the impact of technology development efforts

Several organizations may assess impact on the ATMS of agricultural research. Identify these organizations and analyze the evaluation methods they use.

13. Insure the marketing and use of the product

Describe and analyze the role of agencies involved in market regulation and intervention.

For each participant in the system, its responsibilities and mechanisms for participation in the key functions are described. In descending order of authority, the levels of responsibility of each organization with respect to each function may be described as follows:

1. Decides (makes, or participates in, the final decision).
2. Finances.
3. Coordinates.
4. Executes.
5. Participates in the carrying out of the function.
6. Advises (or is regularly consulted by decision-makers).
7. Informs (in a staff or lobbying function).
8. Requests (as an object rather than executor of the function).

The mechanisms each organization uses to participate in each function may include formal lines of authority, procedures for regular consultation, lobbying by interest groups, or simply an informal exchange of information. Some organizations, or classes of producers, may have no mechanism at all for participating in many of the key functions.

Conceptually, the 13 key functions of ATMS are arrayed at the top of a matrix as columns, all institutions and groups involved in performing a given function and the extent of their involvement can be identified. The number and location of participants in the ATMS help to identify points of strength and weakness. By going across a row, all the functions that a participant performs in the system can be shown, and the concentration or dispersion of effort can be highlighted. This matrix provides a structural map of the system which can highlight duplication, competition or potential for cooperation among participants of the system. It will also demonstrate the absence of certain institutions and/or groups from any influence on functions in which they should be involved.

Microcomputers can be used to store information in a database format. It can be updated as new organizations are created, as the formal functions of all organizations are modified, or as the mechanisms for involvement are changed.

B. Analysis

Different institutions and producer groups of the Sudanese ATMS were identified and listed alphabetically with their acronyms in Table II.1. Each has been classified by principal purpose and subsector: donor (external); technology generating; policy environment; support services; technology transfer; and technology using (Table II.2). These tables confirm the complexity of the Sudanese ATMS. Numerous donors; technology generating, transfer and using organizations are involved in the system. They serve particular client groups, or substitute for some functions not performed by other institutions.

The institutional roles within each key function are identified under each subsector of organizations in Table II.3. The particular mechanisms through which each institution functions and each group related to each function are described in Tables II.4 to II.16.

Policy context of technology generation

Policy plays a critical role in shaping the structure of agricultural production, the efficient use of natural resources, and the context for technology development.

With respect to macro-policy formation (Table II.4), national research institutions do not participate, request, or inform in the macro-economic policies formation. However, individual economists from universities who participate in task force studies, NCR task forces, and PAEA statistics and studies contribute by advising into macro-policy formation. The production performance of the agricultural production corporations has a great influence on the formation of macro-policies. Farmers, tenants, and livestock owners, through their productivity, and unions request the government to adopt and implement policies suitable for input availability and prices. While donors do not participate directly in the decision making, they influence macro-policies in an advisory role through their projects and studies.

Regarding intersectoral resource allocation, decision making, executing, and requesting are functions of various government organizations, e.g., ministries, cabinet, etc. Economists from universities and NCR participate in task forces and committees. Donors financing agricultural development and research projects play an important advising role in the allocation of resources (Table II.5).

The technology generating system must be in a position to provide information to help policy makers -- MANR, MAR, MI, MFEP, CA, CHS, and CM -- establish priorities among competing development objectives and develop agricultural policies. Thus, technology generating systems should strengthen economic studies in collaboration with other organizations in the agricultural sector to contribute in developing agricultural policies.

The incorporation of international, national, and sectoral levels of analysis in developing agricultural policies will influence decisions concerning the relative emphasis on agriculture and industry; the balance of food self-sufficiency versus reliance on imports to meet demand; the determination of national priorities among export and food crops; the reconciliation of the need to keep food prices low for consumers with that of providing sufficient incentives to farmers to expand production; the degree to which price policies or subsidies should be used to stimulate production and adoption of improved technologies; and the equitable distribution of benefits of agricultural research among various sectors and interest groups in the society. All of the decisions demanded by policy issues such as these have a strong impact on the nature of technology which farmers will adopt.

To achieve agricultural development objectives, the Sudan will need to strengthen its present agricultural research capabilities in the institutional building in areas of policy, organization, and management. Particular attention will need to be given to ensuring that research has contributed in developing agricultural development objectives and that research policies are adequately oriented toward agricultural sector objectives and overall development and society goals. This calls for institutional mechanisms at the national level to provide information to help policymakers establish agricultural policies, and to set broad research priorities, allocate resources to these priorities and develop long-term research strategies.

A centralized authority for such a comprehensive national research policy would be necessary. This centralized authority could be established in a form of a council, e.g., Sudan Agricultural Research Council (SARC).

SARC should operate within the general policy frame to develop articulated agricultural development and agricultural research policies, and to ensure consistency of research with the agricultural sector objectives and the national development and society goals. Additional functions of the centralized authority are concerned with research program determination and implementation.

Technology and institutional challenges

To meet the rising demand for agricultural products, increasingly complex and diversified agricultural technologies will be required. New production technologies are needed in both irrigated and rainfed areas for different producer groups under varying conditions. The technology challenge shapes the projection of trends for agricultural research and technology development.

Technological development leading to a sustainable increase in agricultural productivity requires a strong national research system. Equally required are a number of supporting facilities such as national research and training institutions, credit and extension services, infrastructure, input-output markets, and transportation. Improved technologies can increase agricultural production only when farmers are aware of the technologies and know how to use them; when required inputs (seeds, fertilizers, pesticides, etc.) are available at reasonable prices, when markets are accessible; and when there are rumunerative prices for farmers' products. All these are prerequisites for agricultural development and represent important institutional challenges for improving agricultural production.

A national agricultural research system is concerned with determining a research program, implementing it, and communicating appropriately findings to those who need them. Resources (human, physical, and financial), information, know-how, and management and leadership are needed to carry out all these activities in appropriate organization and structure.

External donors have played a major role with respect to human resources training by financing postgraduate and in-service training (Table II.6). International and regional research organizations are participating in the in-service training for Sudanese researchers by providing opportunities for training at their headquarters and in the Sudan. The three Faculties of Agriculture, Institute of Animal Production, and Faculty of Veterinary Sciences in the Sudan have training programs for B.Sc. and M.Sc. degrees. The M.Sc. program, in many cases, is supported by donors. Most of the teaching staff in these institutions have Ph.D.s from British and North American universities.

Research results of national programs of ARC, LVRA, and APRA, and collaborative research with regional and international organizations, play a great role in participating in the generation of political support for agricultural research (Table II.7). University research is aiming more toward publishing articles; and its results are not adapted and verified in farmers' fields. Thus, it has less role in generating political support. Production performance of the production corporations and feedback to decision makers have the major role in generating political support by requesting further implemetation of research results.

External support to research is provided directly by a number of donors through financing research projects, and by executing collaborative and joint research projects with international and regional organizations (Table II.8). Requests for external support come to MFEP from various research institutions for preliminary approval. Final approval is decided by the Cabinet. Small research projects are dealt directly between research institution and donors followed by the approval of the Government. While large research projects are dealt directly with the Government and the concerned research institutions. In this case negotiations with donors are held with the MFEP.

ARC, APRA, and LVRA participate in the meetings of the MAR and MANR for setting agricultural sector goals. Donors and international development agencies advise, through their studies, on sector goals. Production corporations execute their production projects to achieve the production goals (Table II.9).

Resource allocation within the agricultural sector is influenced by donors financing specific activities as well as by various requests from agricultural sector institutions, i.e., services, research, extension, production corporations, sugar companies, and rural and agricultural development projects (Table II.10).

There is no comprehensive national research strategy. Research strategy for APRA and LVRA is prepared by committees and approved by MAR. However, ARC is the only research institution governed by a board of directors. Its research strategy is formulated by the board and approved by the Minister of MANR. Donors could influence research strategy by financing specific researh projects. International and regional research institutions influence the strategy through their participation in the joint research projects (Table II.11).

Research is executed by specialized national agencies. ARC, APRA and LVRA are the leading research institutions of the public sector. Other research is executed by universities and colleges. International and regional organizations execute joint research programs with various national institutions, mainly with ARC, APRA and LVRA (Table II.12). Finance to research comes from Government, the annual budget which is mainly covering salaries up to 80%, from national production corporations, and from donors. Extension agencies participate in research by helping in the execution of on-farm trials. The rural development projects participate in research by carrying out verification trials (Table II. 12).

Transfer of technology is a complex system in Sudan. It is the task of the AFI, APCEU, Rural Development Projects, NAEA, RAEU, WSDP, and others (Table II.13). The private and multilateral production companies, and the private poultry industry are verifying and adopting their own technology. For instance, the multilateral Arab Sudanese Blue Nile Agricultural Company has its testing farm at Agadi to verify maize, sunflower, sesame, and millet seed for its own use in their production farms. Such a complex system is, however, performing an essential technology transfer function and their agents are located close to tenants of the production corporations and farmers in their fields. Most of the research projects financed by donors are covering the technology transfer activities as parts of these projects.

Loans and production inputs are provided by public production corporations, rural development projects, sugar companies and ABS. Marketing services for output are provided by public agencies, e.g., APPC, SCC, SOSC, and LMMC (Table II.14). Donors are financing production inputs, especially for the public corporations.

In the evaluation of impact, donors participate in resource and project evaluation. Task forces are the main tool for evaluating specific projects and carrying out studies (Table II.15). The research system participates, at the individual scientist level, in these task forces.

In marketing and commercial intervention, the CA, CHS and CM decide and approve the bilateral agreements, pricing of main output, exchange rate, and subsidies on staple food and production inputs (Table II.16). The production corporations, unions of farmers, unions of tenants, and others, provide information on cost of production and marketing services to the decision makers.

Fragmentation of technology generation, assessment and transfer programs is the main characteristic of Sudan's technology generation and transfer systems. Therefore, there is need for a systematic planning and programming of agricultural research.

Once program priorities, resource allocation and strategic planning at the macro-level are defined by the propsed SARC, it is at least as important to identify long-term priorities for research activities at national, institute, and program levels.

The long-term plan describes the kind of research identified by the system scientists as necessary to meet the short- and long-term needs of agriculture development. It will help in projecting and using resource efficiently, and will link research with technology transfer systems and users.

Systematic planning and programming of agricultural research will ensure an efficient monitoring and evaluation system to measure research results against planned objectives, introduce interim adjustments, and generate feedback for future planning. The efficient monitoring and evaluation system, therefore, will ensure program relevance, quality and optimal resource use.

C. Recommendations for Improving the ATMS Functions

From the above functional analysis of the Sudanese ATMS, the following issues need careful consideration.

1. Contribution of national research institutions into the formation of macro-policies

Technology-generating institutions' - mainly ARC, APRA and LVRA - role in policymaking is absent. Economists from Khartoum University participating in task forces, NCR task forces, ABS, LMMC, PAEA, SCC, and SOSC statistical and economic studies are the national sources contributing in their advisory role to the macro-policy formulation. While production corporations, through their production performance and producers, through their requests, are influencing macro-policy formulation (Table II.4). Thus, technology-generating institutions should strengthen their economic studies in collaboration with other organizations in the agricultural sector, e.g., production corporations, to contribute in developing agricultural policies. These studies will influence decision making concerning macro-policy issues, e.g., exchange rate, pricing, subsidies, etc.

2. National agricultural research policy

The role of technology-generating institutions in setting agricultural sector goals is limited to the participation of ARC, APRA, and LVRA in joint meetings at the MANR and MAR (Table II.9). Research strategies are decided for ARC by its Management Board, and for APRA and LVRA by committees (Table II. 11). Thus, there is need for a comprehensive national agricultural research policy. This policy is the key step in translating national development objectives into a research program. The lack of a clearly formulated research policy and plans often results in fragmented research programs. Setting research priorities and allocating resources to meet defined development objectives will overcome fragmentation of research programs and attract donors to assist in achieving these defined objectives.

3. A proposed centralized authority: Sudan Agricultural Research Council (SARC)

Implementing the above two recommendations calls for institutional mechanisms at the national level within the general policy frame in the form of a centralized authority to develop agricultural development and agricultural research policies. This centralized authority could be established in the form of a council, e.g., Sudan Agricultural Research Council (SARC), responsible to the ministries concerned with agriculture, livestock, forestry, and natural resources development.

This proposed SARC could combine functions and responsibilities in agricultural research policy formulation and research coordination at the national level of the present ARC Council (Management Board), and the Agricultural Research Council of the NCR. The membership of SARC should include representatives of various parties interested in agricultural research and development, such as, ministries, production corporations, research institutions, universities, development agencies, extension, farmers organizations, etc.

4. Technology generation, assessment, and transfer.

The absence of a comprehensive national agricultural research policy has led to fragmentation of technology generation, assessment and transfer programs. In turn, this has led various research and development institutions to seek donor support to finance technology generation and/or transfer projects, which probably are of minor priority to Sudan (Tables II. 12, 13). Therefore, the need for a systematic planning and programming of agricultural research in the Sudan is obvious.

A national agricultural research system is concerned with determining a research program, implementing it, and communicating findings appropriately
to those who need them.

The planning and programming of agricultural research is an ongoing process and goal oriented, involving rational decision making and optimizing means and use of resources. Determining the research program is associated with decisions over time at national, institutional, operational, and researcher levels. While decisions are made independently at various levels, the levels are connected by the flow of information downwards and upwards through the system.

Once program priorities, resource allocation and strategic planning at the macro level are defined, it is at least as important to identify long-term priorities for research activities at national, institute, and program levels. The resulting long-term plans describe the kinds of research identified by system scientists as necessary for meeting the needs of agricultural development. Thus, the research institutions in Sudan need to formulate their realistic research programs that will assure program relevance and effectiveness. This will help in using resources efficiently, placing increased emphasis on using interdisciplinary teams for problem solving, developing national networks, and linking research with the technology transfer system and users.

Individual scientists participate in research impact studies through their participation in ministry and/or development project task forces (Table II. 15). To ensure effective research program formulation, implementation, interpretation of results, and adoption of technologies, there is need for a monitoring and evaluation system. This system will provide the means for measuring results against planned objectives, introduce interim adjustments, and generate feedback for future planning. In addition, it will ensure program relevance, quality, and optimal resource use.

Table II.1.

SUDAN ATMS Functional Analysis

List of Institutions

ACRONYM	INSTITUTION NAME
ABS	Agricultural Bank of Sudan
ACSAD	Arab Center for the Studies of Arid Zones and Dry Lands
ADB	African Development Bank
ADDF	Abu Dhabi Fund for Development
AFESD	Arab Fund for Economic and Social Development
AFI	Agricultural Field Inspectorates
AHCANR	Abu Haraz college of Agriculture and Natural Resources
ANCANR	Abu Naama college of Agriculture and Natural Resources
AOAD	Arab Organization for Agricultural Development
APCEU	Agricultural Production Corporations Extension Units
APPC	Animal Production Public Corporation
APRA	Animal Production Research Administration
ARC	Agricultural Research Corporation
AVRDC	Asian Vegetable Research and Development Center
BNAPC	Blue Nile Agricultural Production Corporation
BNIARDP	Blue Nile Integrate Agricultural and Rural Development Project
CA	Constituent Assembly
CB	Commercial Banks
CHS	Council of Head of State
CIAT	Centro Internacional de Agricultura Tropical
CIBC	Commonwealth Institute of Biological Control
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CIP	Centro International de La Papa
CM	Council of Ministers
DAEFE	Department of Agricultural Engineering, Faculty of Engineering, Uni.of Khartoum
DANIDA	Danish International Development Agency
DATS	Department of Agriucltural Technicians, Shambat
DFSS	Department of Forestry Studies, Soba
DSRC	Development Studies and Research Centre, University of Khartoum
DVAHK	Department of Veterinary and Animal Husbandry, Kuka
EAPC	Equatoria Agricultural Production Corporation
ECA	Economic Commision for Africa
EEC	European Economic Community
FACC	Foreign Agrochemical Companies
FAO	Food and Agriculture Organization
FASUG	Faculty of Agricultural Sciences, University of Gezira
FAUK	Faculty of Agriculture, Univesity of Khartoum
FF	Ford Foundation
FINIDA	Finish International Development Agency
FNRESUJ	Faculty of Natural Resources and Environmental Studies, University of Yuba
FSC	Foreign Seed Companies
FVS	Faculty of Veterinary Sciences, University of Khartoum
Farmers	Private farmers
Fisherman	Fisherman
GAPC	Gash Agricultural Production Corporation
GTZ	German Agency for Technical Cooperation
Glob. 2000	Global 2000
HRU	Hydrobiological Research Unit, University of Khartoum

IAEA	International Atomic Energy Agency
IAPUK	Institute of Animal Production, University of Khartoum
IBPGR	International Board for Plant Genetic Resources
IBRD	International Bank for Reconstruction and Development
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRAF	International Council for Research in Agroforestry
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Centre
IESUK	Institute of Environment Studies, University of Khartoum
IFAD	International Fund for Agricultural Development
IITA	International Institute for Tropical Agriculture
ILCA	International Livestock Center for Africa
ILRAD	International Laboratory for Research on Animla Diseases
IMF	International Monetary Fund
INTSOMIL	International Sorghum and Millet Program
INTSOY	International Soybean Program
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
JMRDP	Jebel Marra Rural Development Project
KDF	Kuwaiti Fund for Development
KFW	German Bank for Development
LMMC	Livestock and Meat Marketing Corporation
LVRA	Laboratories and Veterinary Research Administration
Livestock	Livestock owners
MANR	Ministry of Agriculture and Natural Resources
MAR	Ministry of Animal Resources
MCCS	Ministry of Commerce, Cooperation and Supply
MFC	Mechanized Farming Corporation
MFEP	Ministry of Finance and Economic Planning
MI	Ministry of Irrigation
MIN	Ministry of Industry
NAEA	National Agricultural Extension Administration
NAPC	Northern Agricutlural Production Corporation
NCR	National Council for Research
ND	Netherland Development Agencies
NHAPC	New Halfa Agricultural Production Corporation
NMAPC	Nuba Mountains Agricultural Production Corporation
NMRDP	Nuba Mountains Rural Development Project
NSAMANR	National Seed Administration, Ministry of Agriculture and Natural Resources
NTC	National Tobacco Company
OAU	Organization of African Unity
ODA	Overseas Development Administration
OPEC	OPEC Fund for International Development
PAEA	Plan. and Agric. Economic Admin., Ministry of Agriuclture and Natural Resources
PMAPC	Private and Multilateral Production Companies
PPI	Private Poultry Industry
RAEU	Regional Agricultural Extension Units
RAPC	Rahad Agricultural Production Corporation
RF	Rockefeller Foundation
SAPC	Suki Agricultural Production Corporation
SAREC	Swedish Agency for Research Cooperation with Developing Countries
SCC	Sudan Cotton Company
SDF	Saudi Fund for Development
SDMANR	Service Department of the Ministry of Agriculture and Natural Resources
SDMAR	Service Depratments of the Ministry of Animal Resources

SEUGB	Socio-Economic Unit, Sudan Gezita Board
SF	Abdelhameed Shuman Foundation
SGB	Sudan Bezira Board
SOSC	Sudan Oil Seed Company
SUER	Socio-Economic Unit, Rahad Agricultural Corporation
Sugar Com.	Sugar Companies
TAPC	Tokar Agricultural Production Corporation
Tenants	Tenants
UNDP	United Nations Development Program
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
VEA	Veterinary Extension Administration
WI	Winrock International
WNAPC	White Nile Agricultural Production Corporation
WSDP	Western Sudan Development Project

Table II.2.

SUDAN ATMS Functional Analysis

Sub-Sector and Purpose of Institution

INSTITUTION	PURPOSE
** SUBSECTOR: Donor	
ADB	Provide funds
ADDF	Providing funds
AFESD	Provide funds
DANIDA	Provide funds
ECA	Provide funds
EEC	Provide funds
FAO	Provide funds
FF	Provide funds
FINIDA	Provide funds
GTZ	Provide funds
IAEA	Provide funds
IBRD	Provide funds
IDRC	Provide funds
IFAD	Provide funds
IMF	Provide funds for Sudan Government
KDF	Provide funds
KFW	Provide funds
ND	Provide funds
ODA	Provide funds
OPEC	Provide funds
RF	Provide funds
SAREC	Provide funds
SDF	Provide funds
SF	Provide funds
UNDP	Provide funds
UNEP	Provide funds
UNIDO	Provide funds
USAID	Provide funds
WI	Provide funds
** SUBSECTOR: Generating	
ACSAD	Plan, fund and execute res. pro. inservice tr. sc.
AHCANR	Teaching. Plan & execute limited res. program
ANCANR	Teaching plan & execute limited res. program
AOAD	Plan and fund agricultural development studies
APRA	Plan and execute res. programs
ARC	Plan, and execute res. programs
AVRDC	Plan, execute res. projects
CIAT	Exch. plant germplasm res.,plan & exec. res. proj.
CIBC	Plan and execute res. projects
CIMMYT	Plan & fund res. projects inserv. train scientists
CIP	Plan and exe. res. proj. inservice training scien.
DAEFE	Teaching. Plan & execute res. programs
DATS	Teaching. Plan & execute limited res. programs
DFSS	Teaching. Plan & execute limited res. programs
DSRC	Teaching. Plan & execute res. programs
DVAHK	Teaching. Plan & execute limited res. programs
FASUG	Teaching. Plan and execute res. programs
FAUK	Teaching. Plan and execute res. program

FNRESUJ	Teaching. Plan & execute res. programing
FVS	Teaching. Plan & execute res. programs
Glob. 2000	Plan, and execute res. projects
HRU	Teaching. Plan & execute res. programs
IAPUK	Teaching. Plan & execute res. programs
IBPGR	Exchange plant germplasm res.,in-service training
ICARDA	Plan, fund and execute res. pro. inserv. tr. sc.
ICRAF	Plan, execute res. projects
ICRISAT	Plan, fund and execute res. proj.in-serv. tr. sc.
IESUK	Teaching. Plan & execute res. program
IITA	Plan and exe. res. proj. in-ser. training scienti.
ILCA	Plan and exec. res. proj. in-serv. training scien.
ILRAD	Plan and exe. res. proj. in-ser. training scienti.
INTSOMIL	Plan, and execute res. project
INTSOY	Plan, and execute res. projects
IRRI	Plan & fund res. projects
ISNAR	Plan & exe. research manag. proj. in-serv. tr. sc.
LVRA	Plan and execute res. programs
NCR	Coordination of research
OAU	Plan and execute agr. studies
PAEA	Plan and execute socio-economic studies
SEUGB	Plan & execute socio-economic studies
SUER	Plan & exec. socio-eco. studies in the Rahad sche.

** SUBSECTOR: Policy

CA	Decide on policy
CHS	Decide on Policy
CM	Decide on policy
MANR	Ag. production policies & services
MAR	Animal production policies & services
MCCS	Formulation of marketing and price policies
MFEP	Macroeconomic policies, planning, financing
MI	Mana. of water resour. and prov. of irri. servi.
MIN	Policies and services of agro-industries

** SUBSECTOR: Services

ABS	Provide cash and kind loans, storage
BNIARDP	Provision of integrated agric. & rural services
CB	Finance local, import-export trade
JMRDP	Provision of intergrated agric. & rural services
LMMC	Provide livestock marketing services
NMRDP	Provision of integrated agri. & rural services
NSAMANR	Multipl. certific. and dist. of improv. seeds
NTC	Provide tobacco marketing services
SCC	Provide cotton marketing services
SDMANR	Provide agricultural services
SDMAR	Provide livestock services
SOSC	Provide oilseed marketing services
WSDP	provision of integrated agri. & rural services

** SUBSECTOR: Transfer

AFI	Technology transfer
APCEU	Technology transfer
NAEA	Technology transfer
RAEU	Technology transfer
VEA	Technology transfer

** SUBSECTOR: User

APPC	Dairy, poultry & fish: production and marketing
BNAPC	Production of crops, rural development
EAPC	Production of crops, rural development
FACC	Production of crops, rural development
FSC	Production of crops, rural development
Farmers	Production and marketing of crops
Fisherman	Fishing and sales
GAPC	Production of crops, rural development
Livestock	production and marketing of livestock
MFC	Provide services for mechanized farming
NAPC	Production of crops, rural development
NHAPC	production of crops, rural development
NMAPC	Production of crops, rural development
PMAPC	Production and marketing of crops
PPI	Production and marketing of poultry & poul. prod.
RAPC	Production of crops, rural development
SAPC	Production of crops, rural development
SGB	Production of crops, rural development
Sugar Com.	Production, processing and marketing of sugarcane
TAPC	Production of crops, rural development
Tenants	Production and marketing of crops
WNAPC	Production of crops, rural developemnt

SUDAN ATMS Functional Analysis
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Institutional Roles

INSTITUTION	MACRO POLICY	INTERSECTOR ALLOCATION	HUMAN RESOURCES	POLITICAL SUPPORT	EXTERNAL SUPPORT	SECTOR GOAL	RESOURCE ALLOCATION	RESEARCH STRATEGY	TECHNOLOGY GENERATION	TECHNOLOGY TRANSFER	SUPPORT SERVICES	IMPACT EVALUATION	MARKETING
** SUBSECTOR: Donor													
ADB	Advise	Finance	Finance	Inform	Finance	None	Finance	Finance	None	Finance	Finance	Participate	None
ADDF	Advise	Finance	None	None	None	None	Finance	None	None	Finance	Finance	Participate	None
AFESD	Advise	None	Finance	None	None	None	Finance	None	Finance	Finance	None	None	None
DANIDA	None	None	Finance	None	None	None	None	None	Finance	Finance	None	Participate	None
ECA	Advise	Advise	None	None	None	None	None	None	Participate	None	None	None	None
EEC	Advise	Advise	Finance	None	Finance	None	Finance	Finance	Finance	None	Finance	None	None
FAO	Advise	Advise	Participate	Inform	Finance	Advise	None	Finance	Finance	Participate	None	Participate	Inform
FF	None	None	Finance	None	Finance	None	None	Finance	Finance	None	None	Participate	None
FINIDA	None	None	Finance	None	None	None	None	None	Finance	None	None	Participate	None
GTZ	None	None	Finance	None	Finance	None	None	None	Participate	Participate	None	None	None
IAEA	None	None	Participate	None	Finance	None	None	Finance	Execute	None	None	None	None
IBRD	Advise	Advise	Finance	Inform	Finance	Advise	Finance	Finance	Finance	Finance	Finance	Participate	Inform
IDRC	None	None	Finance	None	Finance	None	None	Finance	Finance	Finance	None	Participate	None
IFAD	Advise	Advise	Finance	Inform	Finance	Advise	Finance	Finance	Finance	Finance	Finance	Participate	None
IMF	Advise	Advise	None	None	None	Advise	Finance	None	None	None	Participate	None	Inform
KDF	Advise	Finance	None	None	None	None	Finance	None	None	Finance	Finance	Participate	None
KFW	None	None	None	None	None	None	None	None	None	None	None	None	None
ND	None	None	Finance	None	Execute	None	None	None	Finance	Participate	None	None	None
ODA	Advise	Advise	Finance	None	Finance	None	Finance	Finance	Finance	None	Finance	Participate	None
OPEC	None	None	Finance	Participate	Finance	None	Finance	Finance	Finance	Finance	Finance	None	None
RF	None	None	Finance	None	Finance	None	None	Finance	Finance	None	None	None	None
SAREC	None	None	Finance	None	None	None	None	None	Finance	None	None	None	None
SDF	Advise	Finance	None	None	None	None	Finance	None	None	Finance	Finance	Participate	None
SF	None	None	Finance	None	Finance	None	None	Finance	Finance	None	None	None	None
UNDP	Advise	Advise	Finance	Inform	Finance	Advise	Finance	None	Finance	Finance	Finance	Participate	Inform
UNEP	None	None	Participate	Inform	Execute	Advise	Finance	Finance	Finance	None	Finance	Participate	None
UNIDO	Advise	Advise	Participate	Inform	None	None	None	None	Finance	None	Finance	None	Inform
USAID	Advise	Advise	Finance	Inform	Finance	Advise	Finance	Finance	Finance	Finance	Finance	Participate	Inform
WI	None	None	Participate	None	Finance	None	None	None	Participate	None	None	Participate	None
** SUBSECTOR: Generating													
ACSAD	None	None	Participate	Participate	Execute	None	None	Inform	Execute	Participate	None	Participate	None
AHCANR	None	None	Request	Inform	Request	None	None	None	Execute	Participate	None	None	None

ANCANR	None	None	Request	Inform	Request	None	None	None	Execute	Participate	None	None	None
AOAD	Advise	None	Finance	Inform	Execute	Advise	None	None	Execute	None	None	Participate	Inform
APRA	None	None	Request	Participate	Request	Participate	Request	Decide	Execute	Participate	None	Participate	None
ARC	None	None	Request	Participate	Request	Participate	Request	Decide	Execute	Participate	None	Participate	None
AVRDC	None	None	None	None	None	None	None	None	Execute	None	None	None	None
CIAT	None	None	None	None	None	None	None	None	Execute	None	None	None	None
CIBC	None	None	Participate	None	Execute	None	None	None	Participate	None	None	None	None
CIMMYT	None	None	Participate	Participate	Execute	None	None	Participate	Execute	None	None	None	None
CIP	None	None	Participate	Participate	Execute	None	None	Participate	Execute	Participate	None	None	None
DAEFE	None	None	Request	Inform	Request	Advise	None	None	Execute	None	None	Participate	None
DATS	None	None	Request	Inform	Request	None	None	None	Execute	Participate	None	None	None
DFSS	None	None	Request	Inform	Request	None	None	None	Execute	Participate	None	None	None
DSRC	Advise	Advise	Request	Inform	Request	Advise	None	None	Execute	Participate	None	Participate	Inform
DVAHK	None	None	Request	Inform	Request	None	None	None	Execute	Participate	None	None	None
FASUG	None	None	Request	Inform	Request	Advise	None	Participate	Execute	Participate	None	Participate	Inform
FAUK	Advise	Advise	Request	Inform	Request	Advise	None	Participate	Execute	Participate	None	Participate	Inform
FNRESUJ	None	None	Request	Inform	Request	Advise	None	Participate	Execute	Participate	None	Participate	Inform
FVS	None	None	Request	Inform	Request	Advise	None	Participate	Execute	Participate	None	Participate	Inform
Glob. 2000	None	None	None	Participate	Execute	None	None	Participate	Finance	Participate	None	Participate	None
HRU	None	None	Request	Inform	Request	Advise	None	None	Execute	None	None	Participate	None
IAPUK	None	None	Request	Inform	Request	Advise	None	Participate	Execute	None	None	Participate	Inform
IBPGR	None	None	Participate	Participate	Execute	None	None	Participate	Execute	None	None	None	None
ICARDA	None	None	Participate	Participate	Execute	None	None	Participate	Execute	Participate	None	Participate	None
ICRAF	None	None	Participate	None	Execute	None	None	None	Execute	None	None	None	None
ICRISAT	None	None	Participate	Participate	Execute	None	None	Participate	Execute	Participate	None	Participate	None
IESUK	None	None	Request	Inform	Request	Advise	None	Participate	Execute	None	None	Participate	None
IITA	None	None	Participate	None	None	None	None	None	Execute	None	None	None	None
ILCA	None	None	Participate	Participate	Execute	None	None	Participate	Execute	None	None	None	None
ILRAD	None	None	Participate	Participate	Execute	None	None	Participate	Execute	None	None	None	None
INTSOMIL	None	None	Finance	Participate	Execute	None	None	Participate	Finance	None	None	None	None
INTSOY	None	None	None	None	None	None	None	None	Participate	None	None	None	None
IRRI	None	None	Participate	None	None	None	None	None	Execute	None	None	None	None
ISNAR	None	None	Participate	Inform	Execute	None	None	Participate	Execute	None	None	Participate	None
LVRA	None	None	Request	Participate	Request	Participate	Request	Decide	Execute	Participate	None	Participate	None
NCR	Advise	Advise	Decide	Participate	Request	Advise	None	Participate	Coordinate	None	None	Participate	None
OAU	None	None	Finance	None	None	None	None	None	None	None	None	None	None
PAEA	Advise	Advise	Request	Inform	Request	Execute	Request	Advise	Execute	Participate	None	Execute	Inform
SEUGB	None	None	Request	Inform	None	None	None	None	Execute	Participate	None	Participate	Inform
SUER	None	None	Request	Inform	None	None	None	None	Execute	Participate	None	Participate	Inform

** SUBSECTOR: Policy

CA	Decide	Decide	None	None	Decide	Decide	Decide	None	Decide	Decide	Decide	None	Decide
CHS	Decide	Decide	None	None	None	Decide	Decide	None	Decide	Decide	Decide	None	Decide

CM	Decide	Decide	Decide	None	Decide	Decide	Decide	None	Decide	Decide	Decide	Request	Decide
MANR	Participate	Request	Execute	Inform	Request	Decide	Execute	Decide	Decide	Decide	Decide	Execute	Participate
MAR	Participate	Request	Execute	Inform	Request	Decide	Execute	Decide	Decide	Decide	Decide	Execute	Participate
MCCS	Participate	Request	Execute	Inform	Request	Participate	Participate	None	Participate	Participate	Participate	Participate	Participate
MFEP	Execute	Execute	Finance	Decide	Decide	Decide	Execute	Decide	Finance	Finance	Finance	Finance	Participate
MI	Participate	Request	Execute	Inform	Request	Decide	Execute	None	Participate	Participate	Participate	Participate	None
MIN	Participate	Request	Execute	Inform	None	Participate	Participate	None	Participate	Participate	Participate	Participate	Participate
** SUBSECTOR: Services													
ABS	Advise	Inform	Execute	Inform	None	Participate	Request	None	Participate	Participate	Execute	Participate	Execute
BNIARDP	None	None	Request	None	Request	Execute	Request	Participate	Participate	Execute	Execute	Execute	None
CB	None	None	None	None	None	None	Participate	None	None	None	Finance	None	Execute
JMRDP	None	None	Request	None	Request	Execute	Request	Participate	Participate	Execute	Execute	Execute	None
LMMC	Advise	None	Request	Inform	None	Participate	Request	None	Execute	None	Execute	Participate	Advise
NMRDP	None	None	Request	None	Request	Execute	Request	Participate	Participate	Execute	Execute	Execute	None
NSAMANR	Advise	None	Request	None	Request	Participate	Request	Participate	Participate	Execute	Execute	None	None
NTC	None	None	None	None	None	None	None	None	Execute	None	Execute	None	Execute
SCC	Advise	None	None	Inform	None	Participate	None	Participate	Execute	None	Execute	Participate	Execute
SDMANR	None	None	Request	None	Request	Participate	Request	Participate	Participate	Participate	Execute	None	None
SDMAR	None	None	Request	None	Request	Participate	Request	Participate	Participate	Participate	Execute	None	None
SOSC	Advise	None	None	Inform	None	Participate	None	None	Execute	None	Execute	Participate	Execute
WSDP	None	None	Request	None	Request	Execute	Request	Participate	Participate	Execute	Execute	Execute	None
** SUBSECTOR: Transfer													
AFI	None	None	None	None	None	None	Request	Participate	Participate	Execute	Execute	None	None
APCEU	None	None	Request	None	None	None	Request	Participate	Participate	Execute	Execute	Participate	None
NAEA	None	None	Request	None	Request	Participate	Request	Participate	Participate	Execute	Execute	Participate	None
RAEU	None	None	Request	None	None	None	Request	Participate	Participate	Execute	Execute	Participate	None
VEA	None	None	Request	None	None	Participate	Request	Participate	Participate	Execute	Execute	Participate	None
** SUBSECTOR: User													
APPC	Inform	None	Request	Request	None	Execute	Request	Participate	Finance	Execute	Execute	Participate	Execute
BNAPC	Inform	None	Request	Request	None	Execute	Request	Participate	Finance	Execute	Execute	Participate	Participate
EAPC	Inform	None	Request	Request	None	Execute	Request	Participate	Participate	Execute	Execute	Execute	Participate
FACC	None	None	None	None	Participate	None	None	None	Execute	Participate	Execute	None	None
FSC	None	None	None	None	Participate	None	None	None	Execute	Participate	Execute	None	None
Farmers	Request	None	None	Inform	None	Participate	None	Inform	Participate	Request	None	None	Participate
Fisherman	Request	None	None	None	None	Participate	None	Inform	None	Request	None	None	Participate
GAPC	Inform	None	Request	Request	None	Execute	Request	Participate	Finance	Execute	Execute	Participate	Participate
Livestock	Request	None	None	None	None	Participate	None	Inform	None	Request	None	None	None
MFC	None	None	Request	Request	None	Execute	Request	Participate	Finance	Execute	Execute	Participate	Participate
NAPC	Inform	None	Request	Request	None	Execute	Request	Participate	Finance	Execute	Execute	Participate	Participate
NHAPC	Inform	None	Request	Request	None	Execute	Request	Finance	Finance	Execute	Execute	Participate	Participate

NMAPC	Inform	None	Request	Request	None	Execute	Request	Participate	Finance	Execute	Execute	Participate	Participate
PMAPC	Inform	None	None	None	Request	Execute	None	Participate	Participate	Execute	None	None	None
PPI	Request	None	None	None	Request	Participate	None	Inform	Participate	Execute	None	None	None
RAPC	Inform	None	Request	Request	None	Execute	Request	Finance	Finance	Execute	Execute	Participate	Participate
SAPC	Inform	None	Request	Request	None	Execute	Request	Participate	Finance	Execute	Execute	Participate	Participate
SGB	Inform	None	Request	Request	None	Execute	Request	Finance	Finance	Execute	Execute	Participate	Participate
Sugar Com.	Request	None	Request	Inform	None	Execute	Request	Participate	Finance	Execute	Execute	Execute	Participate
TAPC	Inform	None	Request	Request	None	Execute	Request	Participate	Finance	Execute	Execute	Participate	Participate
Tenants	Request	None	None	Inform	None	Participate	None	Inform	Participate	Request	None	None	Participate
WNAPC	Inform	None	Request	Request	None	Execute	Request	Participate	Finance	Execute	Execute	Participate	Participate

Table II.4. SUDAN ATMS Functional Analysis

Macro Policy Formation

INSTITUTION	MECHANISM TO INFLUENCE MACROECONOMIC POLICIES
** MACRO POLICY ROLE: Advise	
ABS	Lobbying and projects
ADB	Projects, studies and meetings
ADDF	Projects
AFESD	Projects
AOAD	Studies
DSRC	Task forces committees
ECA	Studies and meetings
EEC	Evaluation of technical studies
FAO	Projects, studies, workshops and annual meeting
FAUK	Economists in task forces
IBRD	Projects, studies, annual meeting
IFAD	Project, annual meeting, studies
IMF	Meeting, evaluations of economy
KDF	Projects
LMMC	Statistics and studies
NCR	Task forces
NSAMANR	Projects
ODA	Project, studies
PAEA	Statistics and studies
SCC	Statistics and studies
SDF	Projects
SOSC	Statistics and studies
UNDP	Technical studies & projects
UNIDO	Projects
USAID	Project, studies, workshops
** MACRO POLICY ROLE: Decide	
CA	Exchange rate, prices, employment
CHS	Exchange rate, prices, employment
CM	Exchange rate, policy, employment
** MACRO POLICY ROLE: Execute	
MFEP	Financing programs
** MACRO POLICY ROLE: Inform	
APPC	Project
BNAPC	Prod. performance
EAPC	Prod. performance
GAPC	Prod. performance
NAPC	Prod. performance
NHAPC	prod. performance
NMAPC	Prod. performance
PMAPC	Prod. performance
RAPC	Prod. performance
SAPC	Prod. performance
SGB	Production performance
TAPC	Prod. performance
WNAPC	Prod. performance

** MACRO POLICY ROLE: Participate

MANR	Cabinet meetings
MAR	Cabinet meetings
MCCS	Cabinet meeting
MI	Cabinet meetings
MIN	Cabinet meeting

** MACRO POLICY ROLE: Request

Farmers	Productivity, unions, farmers groups
Fisherman	Productivity, union
Livestock	Productivity union
PPI	Input availability, prices
Sugar Com.	Prod. performance
Tenants	Productivity, union

Table II.5. SUDAN ATMS Functional Analysis

Intersectoral Resource Allocation

INSTITUTION	MECHANISM TO INFLUENCE INTERSECTORAL RESOURCE ALLOCATION
** INTERSECTORAL ROLE: Advise	
DSRC	Economists in committees
ECA	Studies
EEC	Projects
FAO	Project proposals
FAUK	Economist in committees
IBRD	Financing projects
IFAD	Financing projects
IMF	Financing policy reforms
NCR	Studies & task forces
ODA	Financing projects
PAEA	Studies, statistics
UNDP	Financing projects
UNIDO	Financing projects
USAID	Financing projects
** INTERSECTORAL ROLE: Decide	
CA	Budgeting
CHS	Budgeting
CM	Budgeting
** INTERSECTORAL ROLE: Execute	
MFEP	Allocating of budget
** INTERSECTORAL ROLE: Finance	
ADB	Financing projects
ADDF	Financing projects
KDF	Financing projects
SDF	Financing projects
** INTERSECTORAL ROLE: Inform	
ABS	Allocation of loanable funds
** INTERSECTORAL ROLE: Request	
MANR	Cabinet meetings
MAR	Cabinet meetings
MCCS	Cabinet meeting
MI	Cabinet meeting
MIN	Cabinet meeting

Table II.6. SUDAN ATMS Functional Analysis

Human Resource Issues

INSTITUTION MECHANISM TO DEVELOP HUMAN RESOURCES

** HUMAN RESOURCES ROLE: Decide

CM	Approval of proposals
NCR	Planning training needs

** HUMAN RESOURCES ROLE: Execute

ABS	Planning
MANR	Planning
MAR	Planning
MCCS	Planning training needs
MI	Planning training needs
MIN	Planning training needs

** HUMAN RESOURCES ROLE: Finance

ADB	In-service training
AFESD	In-service training
AOAD	In-service training (short-term)
DANIDA	In-service training (short-term)
EEC	Post-graduate studies
FF	Post-graduate + in-service
FINIDA	In-service training
GTZ	In-service training
IBRD	Post graduate training
IDRC	Post graduate training in-service
IFAD	Post-graduate, inservice training
INTSOMIL	In-service training
MFEP	Finance training
ND	In-service (short-term)
OAU	In-service training
ODA	Post-graduate, in-service training
OPEC	Post-graduate, inservice training
RF	Post-graduate, post-doctrate
SAREC	In-service training (short-term)
SF	Studies and workshop
UNDP	In-service training
USAID	Post graduate training

** HUMAN RESOURCES ROLE: Participate

ACSAD	In-service at our facilities
CIBC	In-service training
CIMMYT	In-service training
CIP	In-service training
FAO	In-service training
IAEA	In-service training
IBPGR	In-service training
ICARDA	In-service at our facilities
ICRAF	In-service training
ICRISAT	In-service training
IITA	In-service training
ILCA	In-service training
ILRAD	In-service training

IRRI	In-service training
ISNAR	In-service training
UNEP	In-service training
UNIDO	In-service training
WI	Studies, workshops

** HUMAN RESOURCES ROLE: Request

AHCANR	Planning its own, technician training
ANCANR	Planning its own, technicians training
APCEU	Planning
APPC	Planning
APRA	Planning training needs
ARC	Planning training needs
BNAPC	Planning
BNIARDP	Planning
DAEFE	Planning its own, execute others
DATS	Planning its own, technicians training
DFSS	Planning its own, technicians training
DSRC	Planning its own, executing others
DVAHK	Planning its own, technician training
EAPC	Planning
FASUG	Planning its own, execute others
FAUK	Planning its own, execute others
FNRESUJ	Planning its own, execute others
FVS	Planning its own, execute others
GAPC	Planning
HRU	Planning its own, execute others
IAPUK	Planning its own, execute others
IESUK	Planning its own, execute others
JMRDP	Planning
LMMC	Planning
LVRA	Planning training needs
MFC	Planning
NAEA	Planning
NAPC	Planning
NHAPC	Planning
NMAPC	Planning
NMRDP	Planning
NSAMANR	Planning
PAEA	Planning
RAEU	Planning
RAPC	Planning
SAPC	Planning
SDMANR	Planning
SDMAR	Planning
SEUGB	Planning its needs
SGB	Planning
SUER	Planning
Sugar Com.	Planning
TAPC	Planning
VEA	Planning
WNAPC	Planning
WSDP	Planning

Table II.7. SUDAN ATMS Functional Analysis

Generating Political Support

INSTITUTION	MECHANISM TO GENERATE POLITICAL SUPPORT
** POLITICAL	ROLE: Decide
MFEP	Allocation of resource
** POLITICAL	ROLE: Inform
ABS	Financing technology transfer
ADB	Financing technology transfer
AHCANR	Training
ANCANR	Training
AOAD	Studies, meetings
DAEFE	Research results, training
DATS	Training
DFSS	Training
DSRC	research results, training
DVAHK	Training
FAO	Collaborative projects
FASUG	Research results, training
FAUK	Research results training
FNRESUJ	Research results, training
FVS	Research results, training
Farmers	Feedback
HRU	-
IAPUK	Research results, training
IBRD	Financing research projects
IESUK	research results, training
IFAD	Financing research projects
ISNAR	Studies and workshops
LMMC	Statistics and studies
MANR	Lobbying at cabinet level
MAR	Lobbying
MCCS	Lobbying
MI	Lobbying
MIN	Lobbying
PAEA	Statistics and studies
SCC	Statistics and studies
SEUGB	Studies statistics
SOSC	Statistics and studies
SUER	Studies statistics
Sugar Com.	Statistics & feedback
Tenants	Feedback
UNDP	Financing projects
UNEP	Financing research projects
UNIDO	Financing projects
USAID	Financing research projects
** POLITICAL	ROLE: Participate
ACSAD	Collaborative research
APRA	Research results
ARC	Research results
CIMMYT	Collaborative research
CIP	Collaborative research

Glob. 2000	Collaborative research
IBPGR	Collaborative research
ICARDA	Collaborative research
ICRISAT	Collaborative research
ILCA	Collaborative research
ILRAD	Collaborative research
INTSOMIL	Collaborative research
LVRA	Research results
NCR	Studies, workshops
OPEC	Financing research projects, technology transfer

** POLITICAL ROLE: Request

APPC	Stat. and stuies & feedback
BNAPC	Sta. & studies & feedback
EAPC	Stat. and studies & feedback
GAPC	Stat. & studies & feedback
MFC	Stat. and studies & feedback
NAPC	Stat and studies & feedback
NHAPC	Statistics and studies & feedback
NMAPC	Stat. and studies & feedback
RAPC	Statistics and studies & feedback
SAPC	Stat. & studies & feedback
SGB	Statistics, studies and feedback
TAPC	Stat. & studies & feedback
WNAPC	Stat. & studies & feedback

Table II.8. SUDAN ATMS Functional Analysis

External Support to Research

INSTITUTION	MECHANISM OF INVOLVEMENT IN EXTERNAL SUPPORT
** EXTERNAL SUPPORT ROLE: Decide	
CA	Approval
CM	Approval
MFEP	Approval
** EXTERNAL SUPPORT ROLE: Execute	
ACSAD	Collaborative projects
AOAD	Sudan National studies
CIBC	Collaborative projects
CIMMYT	Collaborative projects
CIP	Collaborative projects
Glob. 2000	Collaborative projects
IBPGR	Collaborative research
ICARDA	Collaborative projects
ICRAF	Collaborative projects
ICRISAT	Collaborative projects
ILCA	Collaborative projects
ILRAD	Collaborative project
INTSOMIL	Collaborative projects
ISNAR	Collaborative projects
ND	Tech. transfer
UNEP	Collaborative projects
** EXTERNAL SUPPORT ROLE: Finance	
ADB	Tech. transfer (seeds)
EEC	Finance Tech. transfer
FAO	Collaborative projects
FF	Reserach projects
GTZ	Finance tech. transfer projects
IAEA	Finance special projects
IBRD	Finance research projects
IDRC	Research projects
IFAD	Research projects
ODA	Research projects
OPEC	Research projects
RF	Research projects
SF	Research studies
UNDP	Finance tech. transfer adoption
USAID	Finance WSARP
WI	Collaborative research project
** EXTERNAL SUPPORT ROLE: Participate	
FACC	Technology transfer
FSC	Technology transfer
** EXTERNAL SUPPORT ROLE: Request	
AHCANR	Projects
ANCANR	Project
APRA	Projects
ARC	Projects

BNIARDP	Tech. transfer projects
DAEFE	Projects
DATS	Projects
DFSS	Projects
DSRC	Projects
DVAHK	Project
FASUG	Projects
FAUK	Projects
FNRESUJ	Projects
FVS	Projects
HRU	Projects
IAPUK	Projects
IESUK	Projects
JMRDP	Tech. transfer projects
LVRA	Projects
MANR	Projects
MAR	Projects
MCCS	Export, import quality control
MI	Projects
NAEA	With ARC through ARETP
NCR	Studies & projects
NMRDP	Tech transfer projects
NSAMANR	Tech. transfer projects
PAEA	Economic research projects
PMAPC	Technology transfer
PPI	Technology transfer
SDMANR	Specific tech. transfer
SDMAR	Specific tech. transfer project
WSDP	Technology transfer project

Table II.9. SUDAN ATMS Functional Analysis

Influencing Goals

INSTITUTION	MECHANISM TO INFLUENCE AGRICULTURAL SECTOR GOALS
**** ROLE IN INFLUENCING GOALS: Advise**	
AOAD	Studies
DAEFE	Studies
DSRC	Studies
FAO	Studies
FASUG	Studies
FAUK	Studies
FNRESUJ	Studies
FVS	Studies
HRU	Studies
IAPUK	Studies
IBRD	Studies
IESUK	Studies
IFAD	Studies
IMF	Studies
NCR	Studies & task force
UNDP	Studies
UNEP	Studies
USAID	Studies
**** ROLE IN INFLUENCING GOALS: Decide**	
CA	Goals approval
CHS	Goals approval
CM	Goals approval
MANR	Setting the goals
MAR	Setting the goals
MFEP	Finance dev. projects
MI	setting the goals
**** ROLE IN INFLUENCING GOALS: Execute**	
APPC	Production project
BNAPC	Production project
BNIARDP	Execute projects
EAPC	Production project
GAPC	Production project
JMRDP	Execute projects to achieve the goals
MFC	Production project
NAPC	Production project
NHAPC	Production project
NMAPC	Production project
NMRDP	Execute projects
PAEA	Setting goals
PMAPC	Production project
RAPC	Production project
SAPC	Production project
SGB	Production project
Sugar Com.	Production project
TAPC	Production project
WNAPC	Production project
WSDP	Execute projects

** ROLE IN INFLUENCING GOALS: Participate

ABS	Studies
APRA	Joint meeting with MAR
ARC	Joint meeting with MANR
Farmers	Through unions
Fisherman	Through unions
LMMC	Meetings in the Ministry
LVRA	Joint meetings with MAR
Livestock	Through union
MCCS	Cabinet meeting
MIN	Cabinet meeting
NAEA	Meetings in the Ministry
NSAMANR	Meetings in the Ministry
PPI	Through unions
SCC	Studies
SDMANR	Meetings in the Ministry
SDMAR	Meetings in the Ministry
SOSC	Studies
Tenants	Through unions
VEA	Meetings in the Ministry

Table II.10. SUDAN ATMS Functional Analysis

Resource Allocation within the Agricultural Sector

INSTITUTION	MECHANISM TO INFLUENCE RESOURCE ALLOCATION IN AGRICULTURAL SECTOR
** RESOURCE ALLOCATION ROLE: Decide	
CA	Approval
CHS	Approval
CM	Approval
** RESOURCE ALLOCATION ROLE: Execute	
MANR	Allocation
MAR	Allocation
MFEP	Allocation
MI	Allocation
** RESOURCE ALLOCATION ROLE: Finance	
ADB	Dev. projects
ADDF	Dev. projects
AFESD	Research infrastructure and projects
EEC	Dev. projects
IBRD	Dev. project
IFAD	Dev. projects
IMF	Balance of payment
KDF	Dev. projects
ODA	Dev. projects
OPEC	Dev. projects
SDF	Dev. projects
UNDP	Development project
UNEP	Development project
USAID	Develop projects
** RESOURCE ALLOCATION ROLE: Participate	
CB	Loans
MCCS	Cabinet meeting
MIN	Cabinet meeting
** RESOURCE ALLOCATION ROLE: Request	
ABS	Estimation of agric. production (needs)
AFI	Budget procedure
APCEU	Budget procedure
APPC	Budget procedure
APRA	Budget procedure
ARC	Budget procedure
BNAPC	Budget procedure
BNIARDP	Budget procedure
EAPC	Budget procedure
GAPC	Budget procedure
JMRDP	Budget procedure
LMMC	Budget procedure
LVRA	Budget procedure
MFC	Budget procedure
NAEA	Budget procedure
NAPC	Budget procedure
NHAPC	Budget procedure

NMAPC	Budget procedure
NMRDP	Budget procedure
NSAMANR	Budget procedure
PAEA	Budget procedure
RAEU	Budget procedure
RAPC	Budget procedure
SAPC	Budget procedure
SDMANR	Budget procedure
SDMAR	Budget procedure
SGB	Budget procedure
Sugar Com.	Budget procedure
TAPC	Budget procedure
VEA	Budget procedure
WNAPC	Budget procedure
WSDP	Budget procedure

Table II.11. SUDAN ATMS Functional Analysis

Setting Research Strategy

INSTITUTION	MECHANISM TO INFLUENCE RESEARCH STRATEGY
** RESEARCH STRATEGY ROLE: Advise	
PAEA	Advisory role to the Minister
** RESEARCH STRATEGY ROLE: Decide	
APRA	Committees
ARC	Board of directors
LVRA	Committees
MANR	Approval
MAR	Approval
MFEP	Finance
** RESEARCH STRATEGY ROLE: Finance	
ADB	Tech. transfer
EEC	Research projects
FAO	Research projects
FF	Reserch projects
IAEA	Research projects
IBRD	ARETP research project
IDRC	Research projects
IFAD	Research projects
NHAPC	Problem identification and research finance
ODA	Research projects
OPEC	Research projects
RAPC	Problem identification and research financing
RF	Research project
SF	Research projects
SGB	Problem identification & research financing
UNEP	Research project
USAID	WSARP research projects
** RESEARCH STRATEGY ROLE: Inform	
ACSAD	Within the mandate of ACSAD
Farmers	Production problem
Fisherman	Production problems
Livestock	Production problems
PPI	Production problem
Tenants	Production problems
** RESEARCH STRATEGY ROLE: Participate	
AFI	Problem identification
APCEU	Problem identification
APPC	Problem identification
BNAPC	Problem identification
BNIARDP	Adap. research problem identification
CIMMYT	Collaborative projects
CIP	Collaborative projects
EAPC	Production problem
FASUG	ARC boards
FAUK	ARC boards
FNRESUJ	ARC boards

FVS	Committees
GAPC	Problem identification
Glob. 2000	Collaborative projects
IAPUK	Committees
IBPGR	Collaborative projects
ICARDA	Collaborative projects
ICRISAT	Collaborative projects
IESUK	Committees
ILCA	Collaborative projects
ILRAD	Collaborative projects
INTSOMIL	Collaborative projects
ISNAR	Joint studies
JMRDP	Adp. res. and problem identification
MFC	problem identification
NAEA	Identification of problems
NAPC	Problem identification
NCR	Joint committees
NMAPC	Problem identification
NMRDP	Adap. research problem identification
NSAMANR	Problem identification
PMAPC	Adaptive Res. & production problem
RAEU	Problem identification
SAPC	Problem identification
SCC	Finance cotton research
SDMANR	Problem identification
SDMAR	Problem identification
Sugar Com.	Sugar cane problems
TAPC	problem identification
VEA	Problem identification
WNAPC	Problem identification
WSDP	Adap. research & problem identification

Table II.12. SUDAN ATMS Functional Analysis

Generation of Technology

INSTITUTION MECHANISM TO PARTICIPATE IN TECHNOLOGY GENERATION

** TECHNOLOGY GENERATION ROLE: Coordinate

NCR	Research priorities and joint meetings

** TECHNOLOGY GENERATION ROLE: Decide

CA	Approve sectors finance
CHS	Approve sectors finance
CM	Approve sectors finance
MANR	Allocate resources between sub-sectors & prioriti.
MAR	Allocate resources and set priorities

** TECHNOLOGY GENERATION ROLE: Execute

ACSAD	Joint research program
AHCANR	research programe
ANCANR	Research program
AOAD	Agro-Development studies
APRA	Research programs
ARC	Research programs
AVRDC	Research programs
CIAT	Research programs
CIMMYT	Joint research program
CIP	Joint research programs
DAEFE	Research programs
DATS	Research programs
DFSS	Research program
DSRC	Research program
DVAHK	Research program
FACC	Verification program
FASUG	Research program
FAUK	Research program
FNRESUJ	Research program
FSC	Verification trials
FVS	Research program
HRU	Research program
IAEA	Joint research project
IAPUK	Reserch program
IBPGR	Generic research
ICARDA	Joint research program
ICRAF	Joint research program
ICRISAT	Joint research program
IESUK	Research program
IITA	Indirect research program
ILCA	Joint research
ILRAD	Joint research
IRRI	Research programs
ISNAR	Policy, organization and management studies
LMMC	Marketing studies
LVRA	Research programs
NTC	Providing marketing studies
PAEA	Policy and Economic research
SCC	Marketing studies

SEUGB	Economic research
SOSC	Marketing studies
SUER	Economic research

** TECHNOLOGY GENERATION ROLE: Finance

AFESD	Research infrastructure and research project
APPC	Mini res. program
BNAPC	Mini research programmes
DANIDA	Mini-research projects
EEC	Research projects
FAO	Research projects
FF	Mini-research programs
FINIDA	Mini-research projects
GAPC	Mini research programmes
Glob. 2000	Joint research project
IBRD	Research project
IDRC	research projects
IFAD	Research projects
INTSOMIL	Joint research project
MFC	Mini research programs
MFEP	Allocate resources
NAPC	Mini research programs
ND .	Mini-reserach project
NHAPC	Research programmes
NMAPC	Mini research programs
ODA	Research projects
OPEC	Reserach projects
RAPC	Research programmes
RF	Mini-econ. studies
SAPC	Mini research programmes
SAREC	Mini-research project
SF	Mini-econ. studies
SGB	Research program
Sugar Com.	Sugar cane research programs
TAPC	Mini research programmes
UNDP	Research project
UNEP	Research project
UNIDO	Research projects
USAID	Research project
WNAPC	Mini research programs

** TECHNOLOGY GENERATION ROLE: Participate

ABS	Adoption of technology
AFI	On-farm trials
APCEU	On-farm trials
BNIARDP	Verification trials
CIBC	Resource expertise
EAPC	Problem identification
ECA	Economic studies
Farmers	Demonstration trials and problem identification
GTZ	Joint dev. projects
INTSOY	Genetic resources
JMRDP	Verification trials
MCCS	Cabinet meeting
MI	Cabinet meeting
MIN	Cabinet meeting
NAEA	On-farm trials
NMRDP	Verification trials

NSAMANR	Multiplication of breeder
PMAPC	Verification trials
PPI	problem identification
RAEU	On-farm trials
SDMANR	Problem identification and adoption of tech.
SDMAR	Problem identification and adoption of tech.
Tenants	Demonstration trials and prob. itent.
VEA	On-farm trials
WI	Policy and econ. studies
WSDP	Verification trials - adaptive research

Table II.13. **SUDAN ATMS Functional Analysis**

Transfer of Technology

INSTITUTION	MECHANISM FOR TECHNOLOGY TRANSFER
**** TECHNOLOGY TRANSFER ROLE: Decide**	
CA	Approve sectors finance
CHS	Approve sectors finance
CM	Approve sectors finance
MANR	Allocate resources between sub-sectors
MAR	Allocate resources between sub-sectors
**** TECHNOLOGY TRANSFER ROLE: Execute**	
AFI	Extension role
APCEU	Extension role
APPC	Own extension
BNAPC	Own extension inspectorate
BNIARDP	Demon. & tech. package
EAPC	Own inspectorate
GAPC	Own inspectorate
JMRDP	Demonstration & technology package
MFC	Pilot farming (mechanized farming)
NAEA	Extension role
NAPC	Own inspectorate
NHAPC	Own extension and inspectorate
NMAPC	Own extension and inspectorate
NMRDP	Demon. & tech. package
NSAMANR	Multiplication of seeds
PMAPC	Verifying and adopting technology
PPI	Import & adopt. of technology
RAEU	Extension role
RAPC	Own extension & inspectorate
SAPC	Own extension & impectorate
SGB	Own extension & inspectorate
Sugar Com.	Improve methods of sugar production
TAPC	Own inspectorate
VEA	Extension role
WNAPC	Own extension & inspectorate
WSDP	Demon. & tech. package
**** TECHNOLOGY TRANSFER ROLE: Finance**	
ADB	Rehabilitation projects
ADDF	Rehab. projects
AFESD	Rehabilitation program
DANIDA	Extension projects
IBRD	Extension projects
IDRC	On-farm trials
IFAD	On-farm trials
KDF	Rehab. projects
MFEP	Allocate resources
OPEC	On-farm trials
SDF	Rehabilitation projects
UNDP	FAO projects on extension
USAID	Extension projects

** TECHNOLOGY TRANSFER ROLE: Participate

ABS	Loans to farmers
ACSAD	Demon. trials
AHCANR	Training farmers & technicians, field days
ANCANR	Training farmers and field days
APRA	Demonstration, on-farm trials
ARC	Demonstrations and on-farm trials
CIP	Demons. and on-farm
DATS	Training inspectors & farmers, field days
DFSS	Training inspectors & farmers, field days
DSRC	Rural development studies
DVAHK	Training herdsmen and technicians
FACC	Demonstration
FAO	Demons. and on-farm trials
FASUG	Training of tenants & inspectors
FAUK	Training of extensionists
FNRESUJ	Training of extensionists
FSC	Demonstration
FVS	Training of technicians
GTZ	Extension projects
Glob. 2000	On-farm trials
ICARDA	Demons. and on-farm trials
ICRISAT	Demon. and on-farm trials
LVRA	Demonstrations and on-farm trials
MCCS	Cabinet meeting
MI	Cabinet meeting
MIN	Cabinet meeting
ND	Extension projects
PAEA	Economic studies
SDMANR	Helping extension efforts
SDMAR	Helping extension efforts
SEUGB	Economic studies
SUER	Economic studies

** TECHNOLOGY TRANSFER ROLE: Request

Farmers	Help in problem ident. on-farm trials
Fisherman	Prod. equipment
Livestock	health & prod. facilities
Tenants	Help in problem ident. on-farm trials

Table II.14. SUDAN ATMS Functional Analysis
Support Services to Agriculture

INSTITUTION MECHANISMS FOR PROVIDING SERVICES TO AGRICULTURE

** SUPPORT ROLE: Decide	
CA	Approve sectors finance
CHS	Approve sectors finance
CM	Approve sectors finance
MANR	Allocate resources
MAR	Allocate resources
** SUPPORT ROLE: Execute	
ABS	Loans and prod. inputs
AFI	Extension services
APCEU	Extension services
APPC	Marketing service for output
BNAPC	Loans and prod. inputs
BNIARDP	Loans & prod. inputs
EAPC	Loans and prod. input
FACC	Chemical supplies
FSC	Seed supplies
GAPC	Loans and prod. inputs
JMRDP	Loans & prod. inputs
LMMC	Marketing services
MFC	Pilot farms and maintenance, final output
NAEA	Extension services
NAPC	Loan & Production inputs
NHAPC	Loans and prod. inputs
NMAPC	Prod. inputs
NMRDP	Loans & production inputs
NSAMANR	Seed supply
NTC	Marketing and processing
RAEU	Extension services
RAPC	Loans and prod. inputs
SAPC	Loans & prod. inputs
SCC	Cotton marketing services
SDMANR	Production services
SDMAR	Production services
SGB	Loans and prod. inputs
SOSC	Marketing services
Sugar Com.	Loans and prod. inputs
TAPC	Loans and prod. inputs
VEA	Extension services
WNAPC	Loans and prod. inputs
WSDP	Loans & prod. inputs
** SUPPORT ROLE: Finance	
ADB	Production inputs
ADDF	Rehab. programs
CB	Loans
EEC	Production inputs
IBRD	Production inputs, rehab. programs
IFAD	Production inputs
KDF	Rehab. projects

MFEP	Allocate resources
ODA	Production inputs
OPEC	Production inputs
SDF	Rehab. programs
UNDP	Production inputs
UNEP	Reforestation programs
UNIDO	Prod. inputs plants
USAID	Production inputs

** SUPPORT ROLE: Participate

IMF	Improve trade opportunities
MCCS	Cabinet meetig
MI	Cabinet meeting
MIN	Cabinet meeting

Table II.15.

SUDAN ATMS Functional Analysis
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Evaluation of Impact on ATM System

INSTITUTION MECHANISM TO EVALUATE IMPACT ON ATM SYSTEM
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** EVALUATION ROLE: Execute

BNIARDP	Own project studies
EAPC	Task forces, commissioned studies
JMRDP	Own project studies
MANR	Task forces, committees, reports
MAR	Task forces, committees, reports
NMRDP	Own project studies
PAEA	Macro-level studies
Sugar Com.	Task forces, commissioned studies
WSDP	Own project studies

** EVALUATION ROLE: Finance

MFEP	Allocating funds for evaluation

** EVALUATION ROLE: Participate

ABS	Taks force, commission studies
ACSAD	(macro) Resource evaluation
ADB	Projects
ADDF	Projects
AOAD	Marco-level and import studies
APCEU	Task forces
APPC	Task forces, commissioned studies
APRA	Through task forces (individual)
ARC	Through task forces (individuals)
BNAPC	Task forces, commissioned studies
DAEFE	Task forces (individuals)
DANIDA	Project
DSRC	Task forces (individuals)
FAO	Project studies
FASUG	Through task forces (individuals)
FAUK	Through task forces (individuals)
FF	Finance studies
FINIDA	Projects
FNRESUJ	Through task forces (individual)
FVS	Through taks forces (individual)
GAPC	Task force, commissioned studies
Glob. 2000	Projects, on-going evaluation
HRU	Through task forces (individual)
IAPUK	Through task forces (individual)
IBRD	Resource and project evaluation
ICARDA	Project evaluation
ICRISAT	Project evaluation
IDRC	Finance studies
IESUK	through task force (individual)
IFAD	Resource and projects
ISNAR	macro-level studies
KDF	Projects
LMMC	Macro-level studies
LVRA	Through task forces (individuals)
MCCS	CM meeting

MFC	FAsk forces, commissioned studies
MI	Through CM meeting
MIN	CM meeting
NAEA	Task forces
NAPC	Taks forces, commissioned studies
NCR	Research import studies
NHAPC	Task force commissioned studies
NMAPC	Task forces, commissioned studies
ODA	Projects
RAEU	Task forces
RAPC	Task forces, Commissioned studies
SAPC	Task force, commissioned studies
SCC	Macro-level studies
SDF	Projects
SEUGB	Micro-level studies
SGB	Commissioned studies
SOSC	Macro-level studies
SUER	Micro-level studies
TAPC	Task forces, commissioned studies
UNDP	Project studies
UNEP	Resource evaluation
USAID	Resource and project evaluation
VEA	Task forces
WI	Finance studies
WNAPC	Taks forces, commissioned studies

** EVALUATION ROLE: Request

CM	from Ministries MANR & MAR

Table II.16. SUDAN ATMS Functional Analysis
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Marketing and Commercial Intervention

INSTITUTION	MECHANISM FOR INVOLVEMENT IN MARKETING AND DISTRIBUTION
** COMMERCIAL ROLE: Advise	
LMMC	Statistics and studies
** COMMERCIAL ROLE: Decide	
CA	Bi-lateral agr., pricing of main output, exch. rate subsidies monopoly acts
CHS	Bi-lateral agr., pricing of main output, exch. rate subsidies monopoly acts
CM	Bi-lateral agr., pricing of main output exch. rate subsidies monopoly acts
** COMMERCIAL ROLE: Execute	
ABS	Buffer stock, agri- import
APPC	Provide marketing services
CB	Financing import - export trades
NTC	Pricing of tobacco
SCC	Statistics and studies
SOSC	Statistics and studies
** COMMERCIAL ROLE: Inform	
AOAD	Macro-level studies
DSRC	Studies
FAO	Statistics & projections
FASUG	Studies
FAUK	Studies
FNRESUJ	Studies
FVS	Studies
IAPUK	Studies
IBRD	Statistics projects
IMF	Exchange rate advise to promote export
PAEA	Studies and stat.
SEUGB	Statistics
SUER	Statistics
UNDP	Statistics & projections
UNIDO	Statistics and projection
USAID	Studies
** COMMERCIAL ROLE: Participate	
BNAPC	Cost of prod. and marketing services
EAPC	cost of prod. and marketing services
Farmers	Unions
Fisherman	Unions
GAPC	Cost of prod. and marketing service
MANR	Proposals and CM meeting
MAR	Porposal and CM meeting
MCCS	Pricing, exchange rate
MFC	Provide input
MFEP	Allocation of funds
MIN	Pricing of output
NAPC	Cost of prod. and marketing services

NHAPC	Cost of prod. and marketing services
NMAPC	Cost of prod. and marketing services
RAPC	cost of prod. and marketing services
SAPC	Cost of prod. and marketing services
SGB	Cost of prod., studies, marketing services
Sugar Com.	Marketing services
TAPC	cost of prod. and marketing services
Tenants	Unions
WNAPC	Cost of prod. and marketing services

Part III

Institutional Analysis

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Part III

INSTITUTIONAL ANALYSIS

Introduction

The data reported in this chapter were supplied by officials of Sudanese institutions involved in agricultural research.

ISNAR has aggregated these data - simply as they have been reported - and has attempted to analyze them and to draw conclusions.

Table 1 presents an institutional profile summary of the eight most prominent agricultural research organizations. Included in the profile are the dates of the first activities of the organizations, legal status, affiliation, mandates, functions and linkages.*

Overview

Figure 1 shows the total number of scientists - Ph.D.s, M.Sc.s and B.Sc.s - at the eight most prominent Sudanese agricultural research institutions. Abbreviations on the horizontal axis are as follows:

apra	Animal Production Research Administration
arc	Agricultural Research Corporation
engfac	Department of Agricultural Engineering, Faculty of Engineering, University of Khartoum
gefac	Faculty of Agricultural Sciences, University of Gezira
iap	Institute of Animal Production, University of Khartoum
khfac	Faculty of Agriculture, University of Khartoum
vetfac	Faculty of Veterinary Sciences, University of Khartoum
vra	Laboratories and Veterinary Research Administration

There are several clear conclusions to be drawn from this figure.

(1) The ARC is by far the largest single organization involved in agricultural research in Sudan. Its primary focus is on crops research.

(2) But - taken together - the two non-university organizations involved in livestock research, APRA and VRA, plus IAP (University of Khartoum), are more than 3/4 the size of the ARC.

(3) The two university faculties involved mainly in crops research (GEFAC, KHFAC) are more than 2/3 the size of the ARC.

(4) And taken together, the four organizations involved in livestock research (APRA, IAP, VRA, VETFAC) are almost 2/3 the size of the four organizations involved mainly in crops research (ARC, ENGFAC, GEFAC, KHFAC).

* For more information on organizational structure of research institutions, see the attached chart at the end of this report.

Table 1: Institutional Profile -Sudanese Agricultural Research Organizations - 1987

Institution	Date of 1st Activities	Legal Status	Affiliation	Mandate			Principal Functions				Linkages		
				Focus	Region	Client	Research	Tranfer and Service	Production	Policy	Technology Sector	Policy Sector	External Environment
Animal Production Research Administration	1957	Public	Ministry of Animal Resources	Research	Sudan	Animal Owners Private & Public Institutions	Applied Adaptive	Extension input Human Services	----	----	Faculty of Vet. Science Institute of Animal Production	Ministry of Animal Resources	ALSAD, ILCA Irish AID
Agricultural Research Corporation	1902	Semi-autonomous	Ministry of Agriculture & Natural Resources	Applied and Adaptive Research	Sudan	Farmers Agricultural Corporations Companies	Applied Adaptive	Extension Human Services	----	----	Universities NCR Polytechnics NEA	Ministries of Agriculture, Finance and Industry NCR	ICARDA, ICRISAT, IDRC, FAO, IFAD, CIMMYT, INTSORMIL
Agricultural Engineering University of Khartoum	1981	Semi-autonomous	University of Khartoum	Teaching and Research	Sudan	Students Public & Private Institutions	Applied Adaptive	Human Services	----	----	Faculty of Agriculture	University of Khartoum	----
Faculty of Agricultural Science, University of Gezira	1978	Semi-autonomous	University of Gezira	Teaching and Research	Central Region	Students Farmers Animal Owners	Basic Applied	Extension Human Services	----	Advice	ARC, APRA, VRA, NCR, University of Khartoum	Central Region Government	Ford Foundation, IDRC, World Bank, University of Hohenheim
Institute of Animal Production,University of Khartoum	1983	Semi-autonomous	University of Khartoum	Teaching and Research	Sudan	Students Animal Owners	Basic Applied	Extension Human Services	----	----	Faculty of Vet. Science Faculty of Agriculture APRA, VRA	University of Khartoum	HEDCO
Faculty of Agriculture, University of Khartoum	1938	Semi-autonomous	University of Khartoum	Teaching and Research	Sudan	Students Farmers	Basic Applied	Extension Human Services	----	Advice	ARC, NCR other Faculties	University of Khartoum	ICRISAT, ICARDA, CIMMYT, INTSORMIL, USAID, Belfast University
Faculty of Vet. Science University of Khartoum	1938	Semi-autonomous	University of Khartoum	Teaching and Research	Sudan	Students Animal Owners	Basic Applied	Extension Human Services	----	----	APRA, VRA, NCR, Faculty of Agriculture	University of Khartoum	USAID, British Council ODM, Institute of Animal Production and Tropical Medicine
Laboratories and Veterinary Research Administration	1913	Public	Ministry of Animal Resources	Research	Sudan	Public Institutions Farmers	Basic Applied Adaptive	Extension Inputs Human Services	Laboratory Services	Execute	Faculty of Vet. Science Inst. of Animal Protection	Ministry of Animal Resources	SIDA, AEA, ODA, FAO, GTZ, EEC

(5) More than 50% of the scientists involved in agricultural research in the Sudan hold Ph.D. degrees.

Figure 2 presents the same data in a different way. It shows the ratio between (a) numbers of Ph.D.s and (b) numbers of scientists at each of the eight organizations.

(6) Not surprisingly, three of the four highest ratios are in three of the university faculties (GEFAC, KHFAC, VETFAC).

(7) The most striking feature of this figure is that only two organizations have a ratio appeciably below 0.5. The inevitable question, therefore, is: are Sudanese research organizations running a danger of becoming top-heavy? Do they have now and will they have in the future enough B.Sc.s and technicians to do the routine jobs involved in research?

Figure 3 attempts to answer at least part of this question. It shows the ratio between (a) numbers of technicians and administrators (combined) and (b) numbers of scientists.

(8) Only one organization has a ratio above 2.0. Policy-makers and research managers must therefore raise serious questions as to whether most scientists have the manpower resources necessary to carry out their experiments. Such figures are made still more ominous by the fact that the numerator of the ratios reported includes BOTH technicians and administrators.

(9) Continuing with this logic, a reexamination of Figure 1 shows that approximately 75% of the scientists involved in agricultural research in the Sudan hold either the Ph.D. or the M.Sc. degree.

The Agricultural Research Corporation

Figures 4 shows the scientists in the ARC by their professional discipline and level of academic qualification. Abbreviations on the horizontal axis are as follows:

agro	Agronomy
bot	Botany/Pathology
cbre	Cotton Breeding
econ	Statistics/Economics
ent	Entomology
fish	Fisheries
food	Food Science
for	Forestry
hort	Horticulture
pbre	Plant Breeding
soil	Soil Science
wild	Wildlife
docd	Ph.D.
masd	M.Sc.
bacd	B.Sc.

Several conclusions may be drawn from these two figures.

(10) Somewhat surprisingly, one of the two largest disciplines within the ARC in terms of total manpower is food science.

(11) No marked imbalances in manpower strength exist between the traditional crop science disciplines: agronomy, botany/pathology, breeding, entomology, horticulture, and soil science.

(12) But these same disciplines stand in significant contrast to other disciplines in terms of the balance between Ph.D.s and M.Sc.s. All of them have significantly more Ph.D.s - while economics, engineering, fisheries, forestry, and wildlife (almost) have more M.Sc.s.

One conclusion to be drawn from this last finding may be that policy-makers and research managers will probably wish to consider soon the desirability of bringing new B.Sc.s into the traditional disciplines, while at the same time giving priority in Ph.D. training in non-traditional disciplines.

Figure 5 shows similar data, but this time including scientists now in training. Conclusions nos. 10-12 still seem to apply.

Figure 6 shows ARC scientists by commodity specialization and level of academic qualification. The data here are difficult to interpret. First, the number of Ph.D.s reported is considerably higher than the number reported by discipline. The difference is approximately 12%. Second, scientists in two categories - food science and wsarp (the Western Sudan Agricultural Research Project) - should have been reported under specific commodities.

(13) Nevertheless, even with these limitations, it is clear from the figure that attention to cotton continues to dominate Sudanese agricultural research.

(14) Between other commodities, there are no marked imbalances - except that oils receive somewhat less attention than might have been expected.

(15) And, just as reported above, attention to the more traditional commodities is greater than to fisheries, forestry, and wildlife (unreported here) in terms of the balance between Ph.D.s and M.Sc.s.

Again, a conclusion to be drawn from this finding may be that policy-makers and research managers may wish to consider the desirability of encouraging new B.Sc.s to work on the traditional commodities, while at the same time giving priority in Ph.D. training to candidates who wish to work on non-traditional commodities.

Figure 7 takes these commodity data and relates them to expenditure. Research on commodities which show higher percentages of Ph.D.s than of the expenditure is probably more labor intensive than the other way around. A major problem with the data, however, is the almost 19% of expenditure which is reported under the category "other".

(16) Nevertheless, a justifiable conclusion seems to be that research on commodities like horticulture, cotton, sorghum, and sugar is more labor intensive than research on faba, oils, or wheat.

Figure 8 shows expenditure on six major crops over time. (Faba research is not included because most funds have come from a special international project and because the figures reported have been constant for the past 5-6 years).

(17) Not surprisingly, expenditure on cotton research has been top of the table each year since 1980.
Expenditure on wheat and oils research has risen quite sharply (in spite of conclusion no.14 above).
Expenditure on horticulture research, on the other hand, has remained quite low.

Figure 9 shows the ratio between technicians and scientists both by discipline and by station. Figure 10 shows this ratio over time by discipline. Abbreviations on the horizontal axis of Figure 10 are as follows:

elo	El Obeid
gun	Guneid
hud	Hudeiba
kad	Kadugli
ken	Kenana
newh	New Halfa
rah	Rahad
senn	Sennar
sham	Shambat
shen	Shendi
yam	Yambio

(18) The most obvious feature of the station data is the wide variation between Guneid, Hudeiba, and Shendi (on the high end) and El Obeid, Kadugli, New Halfa, Rahad, and Yambio (on the low end). The explanation for this wide variation is not clear.

(19) The discipline data shows a similar wide variation. But more significant than the variation are the low numbers. Only cotton breeding, entomology, and forestry have a ratio greater than 2.0. Once again - (see conclusion no.8 above) -

policy-makers and research managers should have serious questions as to whether most scientists have the manpower resources necessary to carry out their experiments.

(20) Even more ominous, Figure 10 shows that the ratio in 1987 is lower than that in 1975 for all but three disciplines: cotton breeding, plant breeding, and food science.

Livestock Research

Figure 10 shows the distribution of scientists involved in livestock research by organization and level of academic qualification. Abbreviations on the horizontal axis are as follows:

apra	Animal Production Research Administration
iap	Institute of Animal Production, University of Khartoum
vetfac	Faculty of Veterinary Sciences
vra	Laboratories and Veterinary Research Administration

(21) The most striking conclusion to be drawn from this figure is the manpower dominance of veterinary science over animal production. Approximately 3/4 of the total scientists involved in livestock research are in the two organizations concerned with vet science (VETFAC, VRA).

(22) In terms of number of doctorates, the dominance of vet science is even more pronounced. The ratio of doctorates in FVS and LVRA to doctorates in APRA and AIP is almost 5:1.

Figure 11 shows all scientists involved in livestock research by professional discipline and level of academic qualification. Abbreviations on the horizontal axis are as follows:

bree	Breeding
dair	Dairy
meat	Meat
mgt	Management/Administration
nutr	Nutrition
poul	Poultry
bact	Bacteriology
ent	Entomology
myco	Mycology
mycp	Mycoplasma
para	Parasitology
path	Pathology
proz	Protozoology
vir	Virology

anat	Anatomy
med	Medicine
micr	Microbiology
phys	Physiology
prev	Preventive Medicine
rad	Radioisotopes
surg	Surgery

The data here are difficult to interpret because responding institutions have sometimes blurred the distinction between discipline (e.g., breeding, nutrition) and commodity (e.g., poultry). Several tentative conclusions can be drawn from the figure nevertheless.

(23) As expected, disciplines traditionally associated with veterinary science are over-represented in comparison with those associated with animal production. The three biggest disciplines are pathology, parasitology, and bacteriology - while breeding is very small.

(24) Slightly less than 50% of all animal scientists and vets have doctorates. Most disciplines do not seem too top-heavy - with the possible exceptions of anatomy, microbiology, medicine, preventive medicine, and surgery.

Figures 12-13 present data from APRA. Figure 12 shows scientists by location and level of academic qualification. Figure 13 shows the ratio between technicians and scientists by location (excluding headquarters, for which data were not available). Abbreviations on the horizontal axis are as follows:

atbr	Atbara
ghaz	Ghazala Gawzat
hq	Headquarters
hud	El-Huda
kufa	Kuku Fattening Unit
kunu	Kuku Nutrition Lab
kupo	Kuku Poultry Unit
nish	Nisheisheba
shuk	Ash-Shukaba
umba	Umm Benein

(25) Almost all Ph.D. holders are located in Khartoum or the immediate vicinity (i.e. Kuku).

(26) The absolute number of scientists posted outside Khartoum or Kuku is very small.

(27) Only two units have a technician-to-scientist ratio of more than 2.0. And KUFA and KUNU actually report data resulting in ratios below 1.0.

Figures 14-15 present data from VRA. Figure 15 shows scientists by discipline and level of academic qualification. Figure 15 shows the ratio between technicians and scientists by discipline.

(28) No marked imbalances in manpower exist between the traditional veterinary science disciplines: bacteriology, mycoplasma, parasitology, pathology, and virology.

(29) But the ratios between technicians and scientists are very low. Only one discipline (entomology) has a ratio higher than 1.5 - and four disciplines have ratios below 1.0.

Once again, as in the cases of both APRA and ARC, an inescapable conclusion must be that policy-makers and research managers will need to ask soon whether highly qualified scientists have the manpower resources necessary to carry out their work.

FIGURE 1

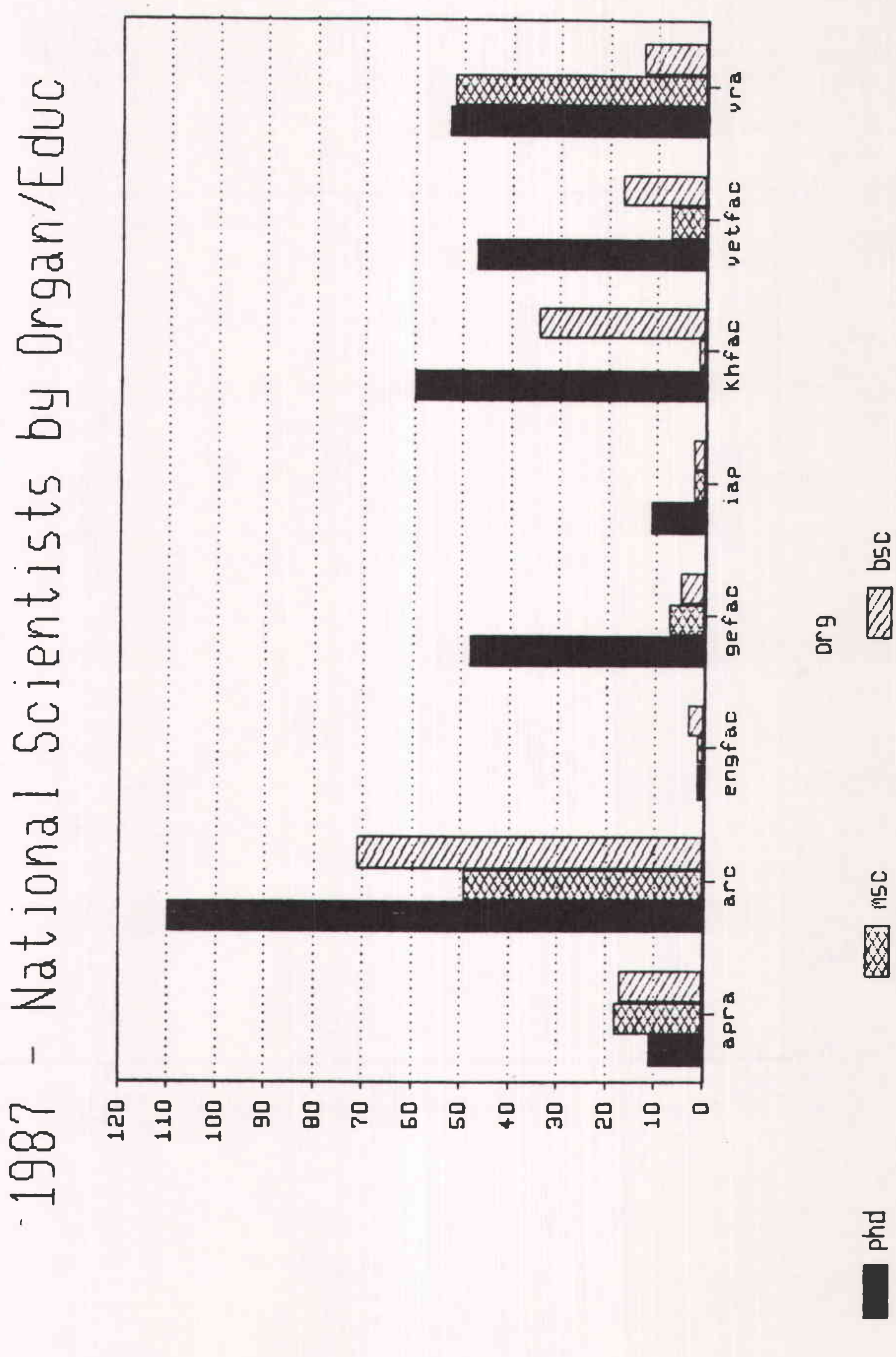

1987 - National Scientists by Organ/Educ
0
10
20
30
40
50
60
70
80
90
100
110
120
apra
arc
engfac
gefac
iap
khfac
vetfac
vra
org
phd
msc
bsc

FIGURE 2

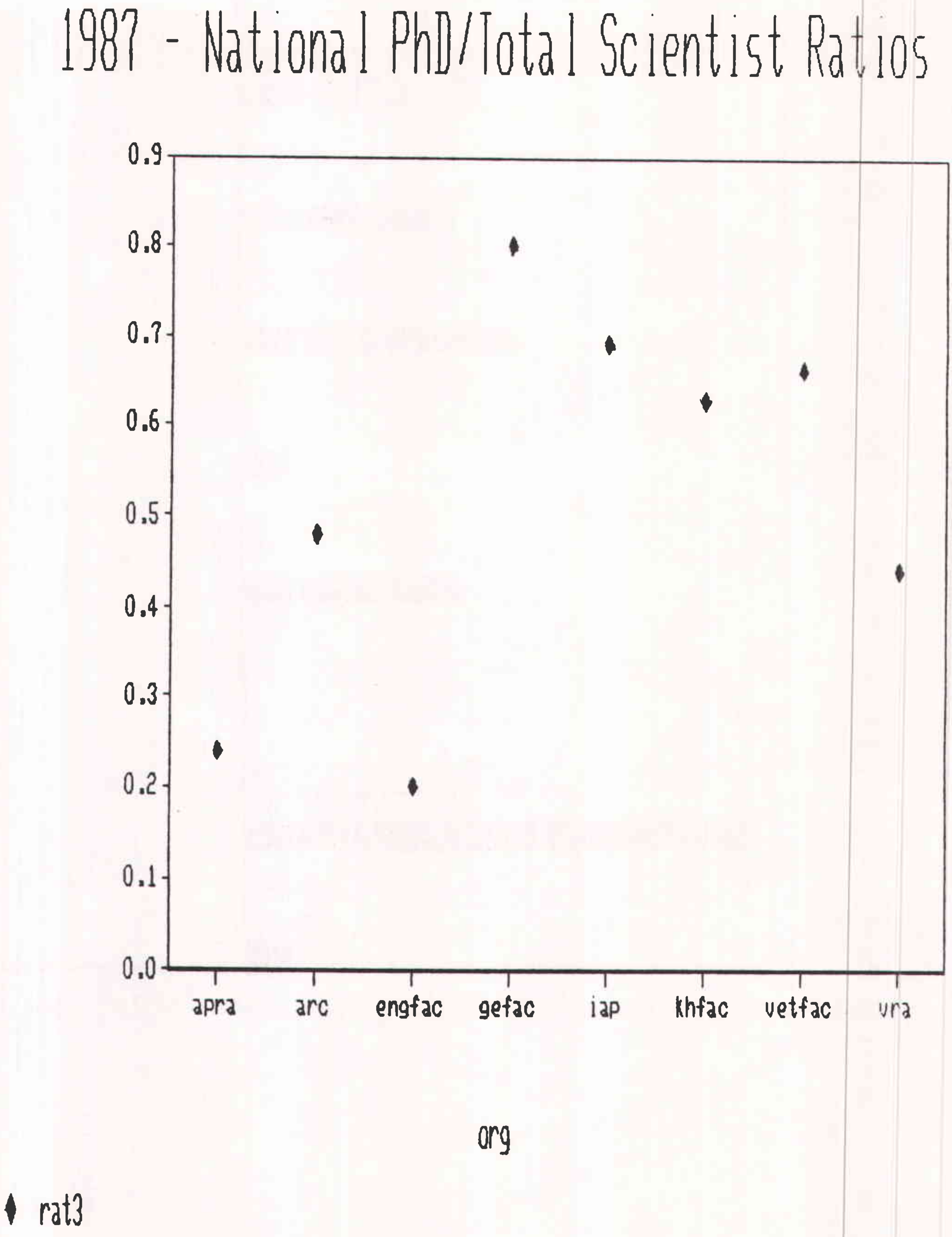
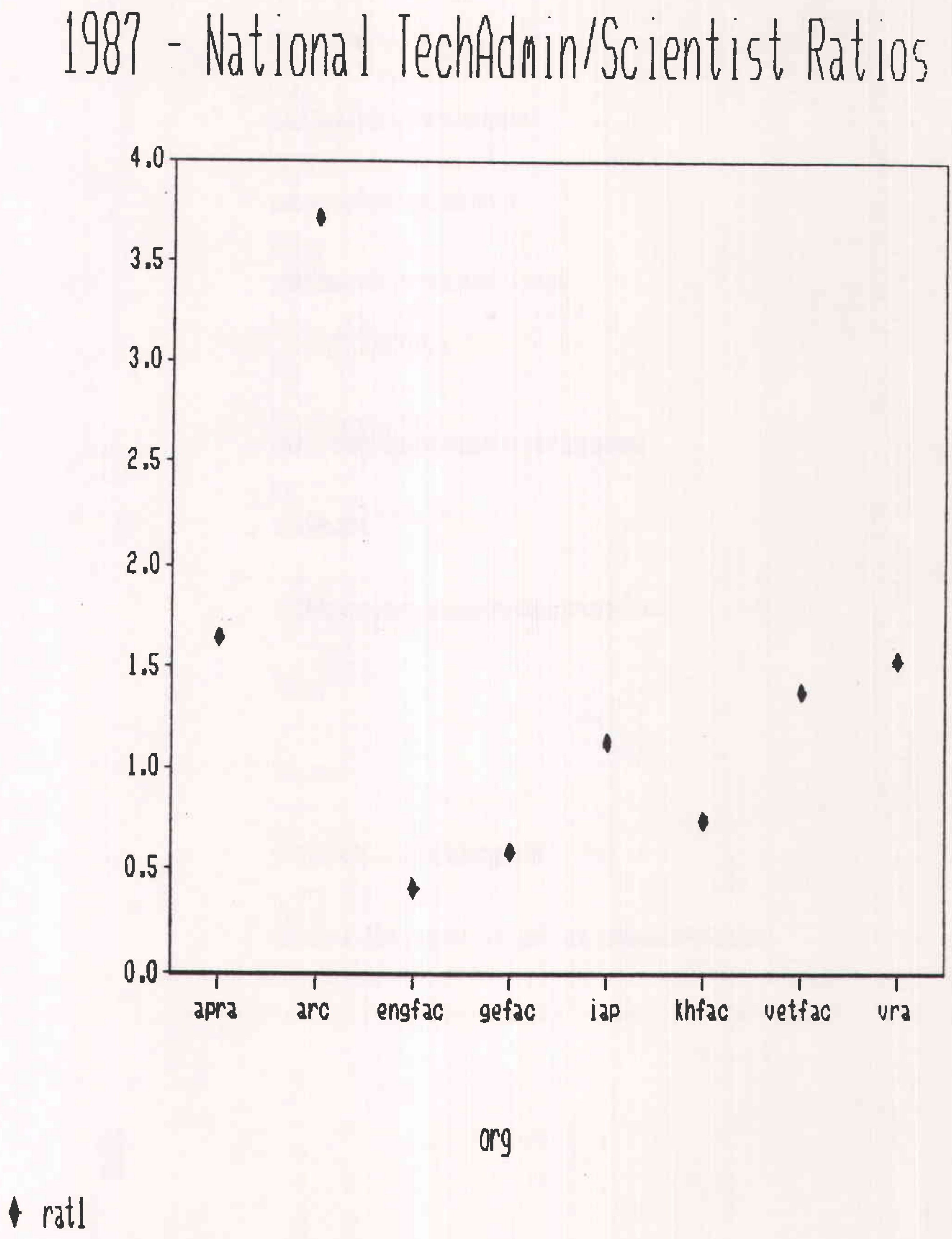

1987 - National PhD/Total Scientist Ratios
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
apra
arc
engfac
gefac
iap
khfac
vetfac
vra
org
rat3

FIGURE 3



1987 - National TechAdmin/Scientist Ratios
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
apra
arc
engfac
gefac
iap
khfac
vetfac
vra
org
ratl

FIGURE 4

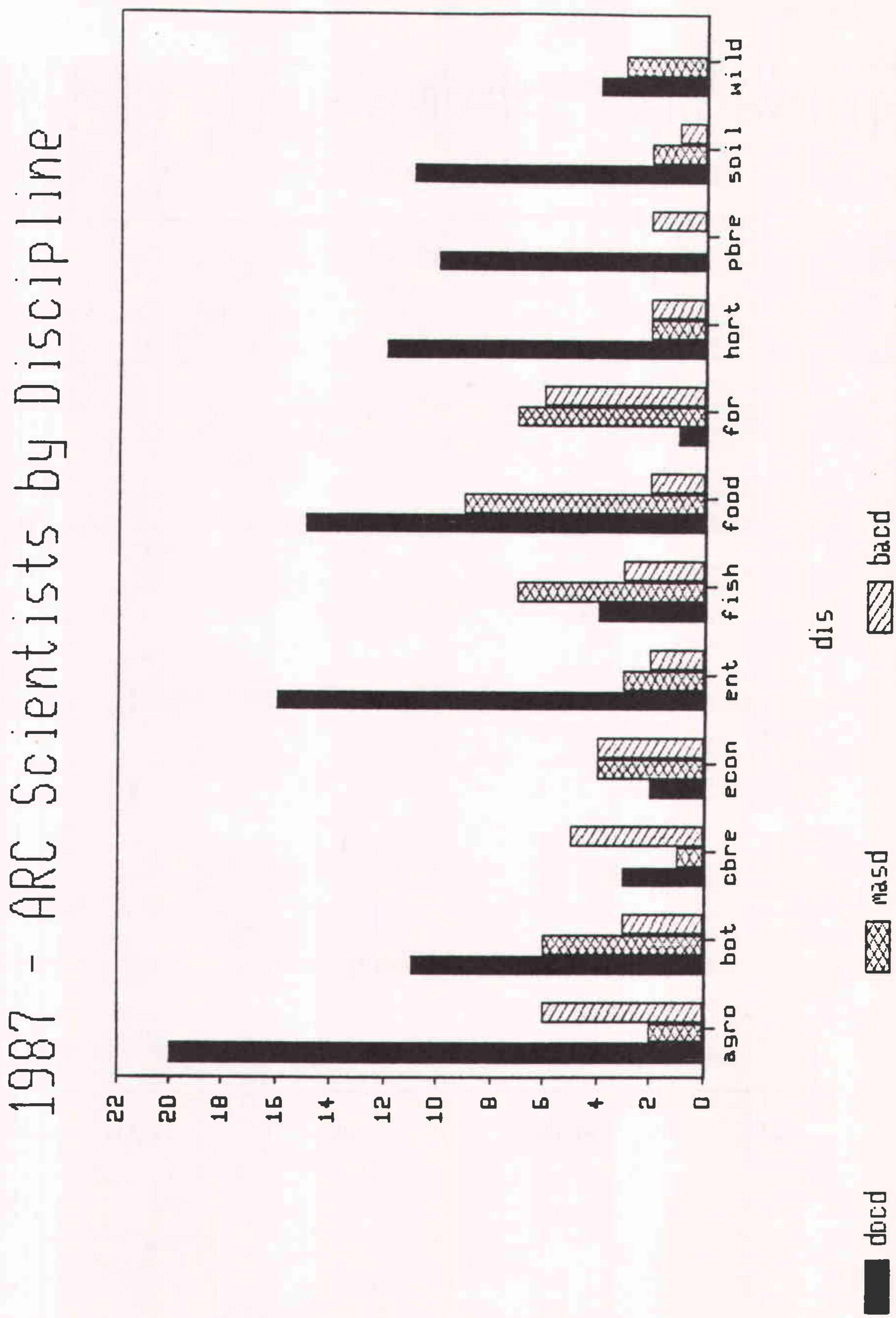
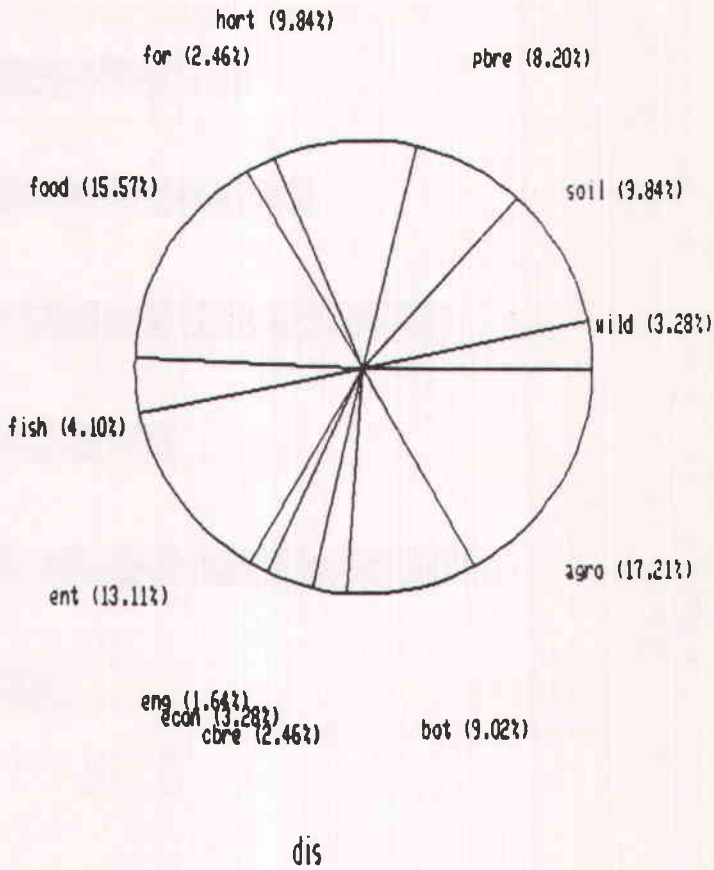

1987 - ARC Scientists by Discipline
22
20
18
16
14
12
10
8
6
4
2
0
agro
bot
cbre
econ
ent
fish
food
for
hort
pbre
soil
wild
dis
docd
masd
bacd

FIGURE 5

ARC - Future PhD's By Discipline



ARC - Future PhD's and MSc's By Discipline

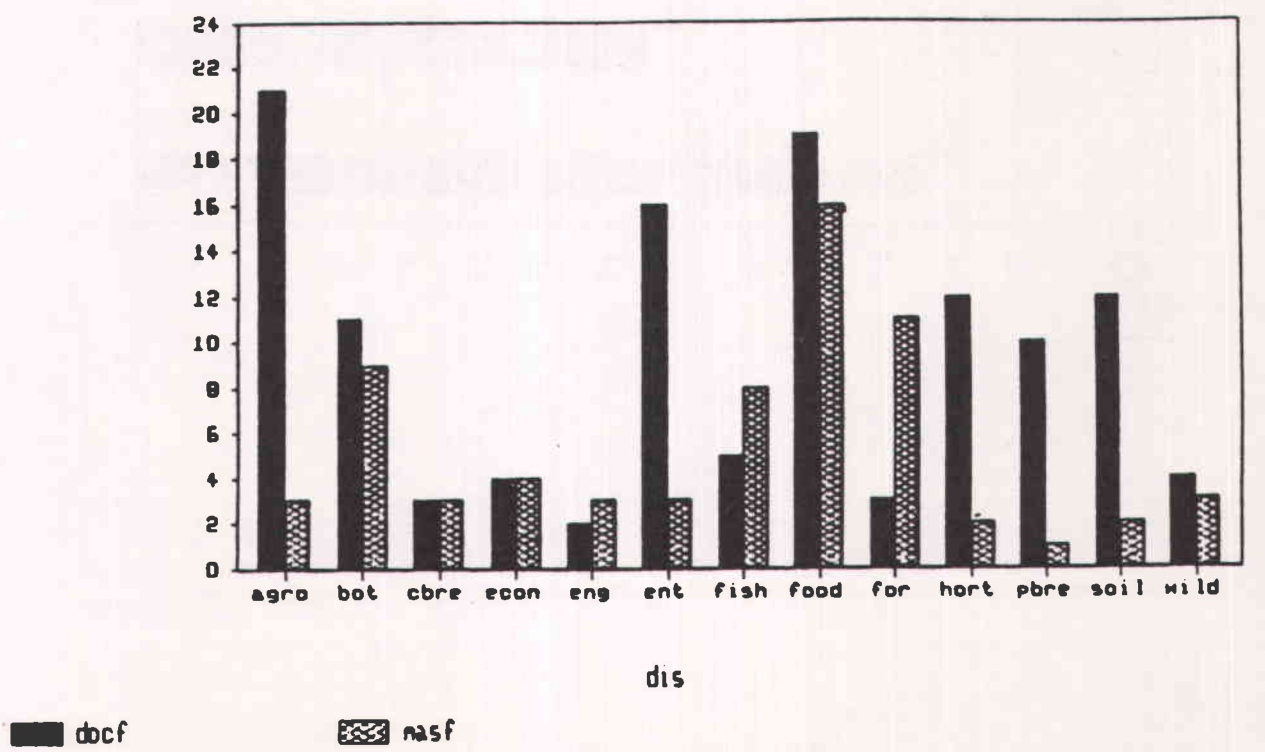


FIGURE 6

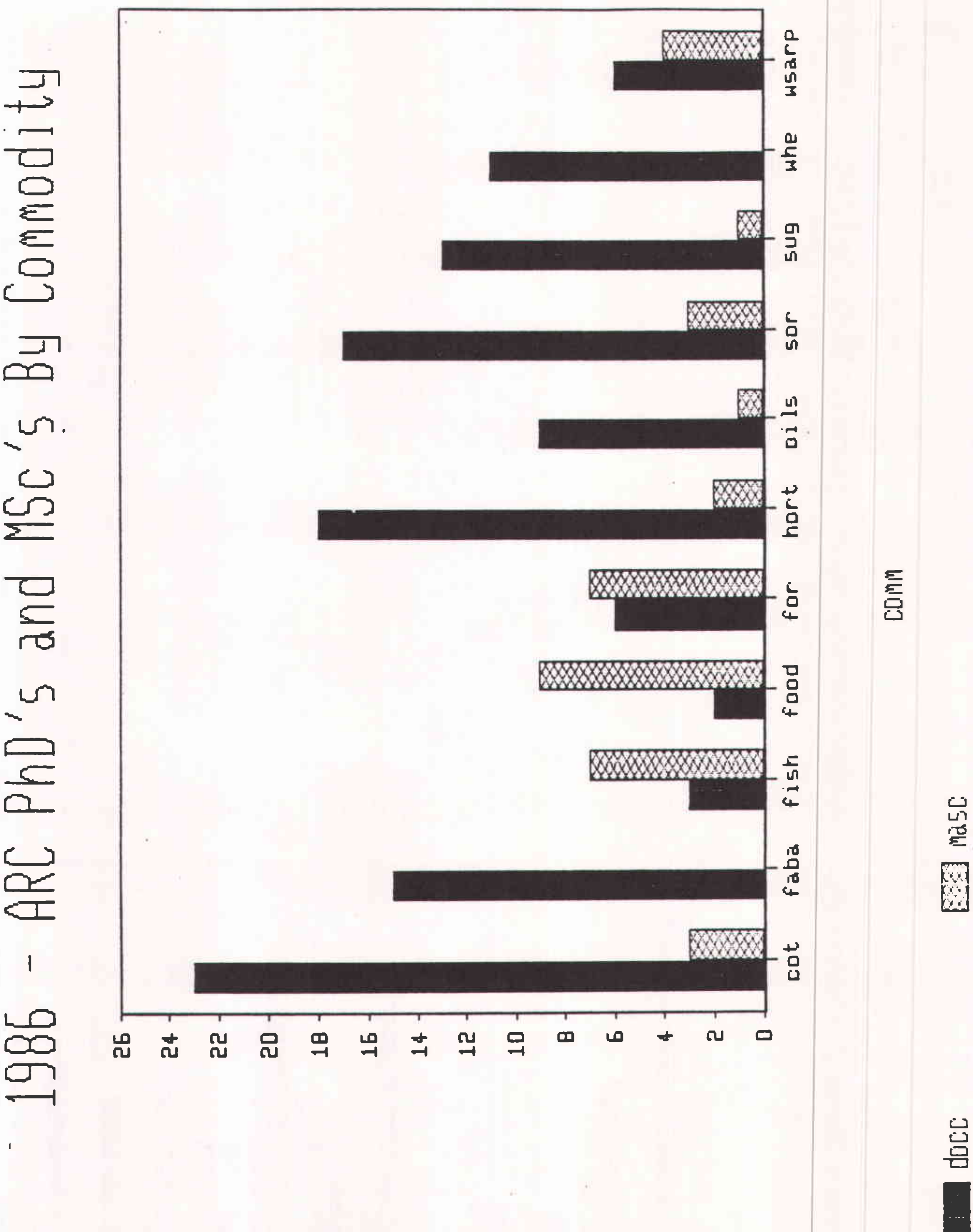
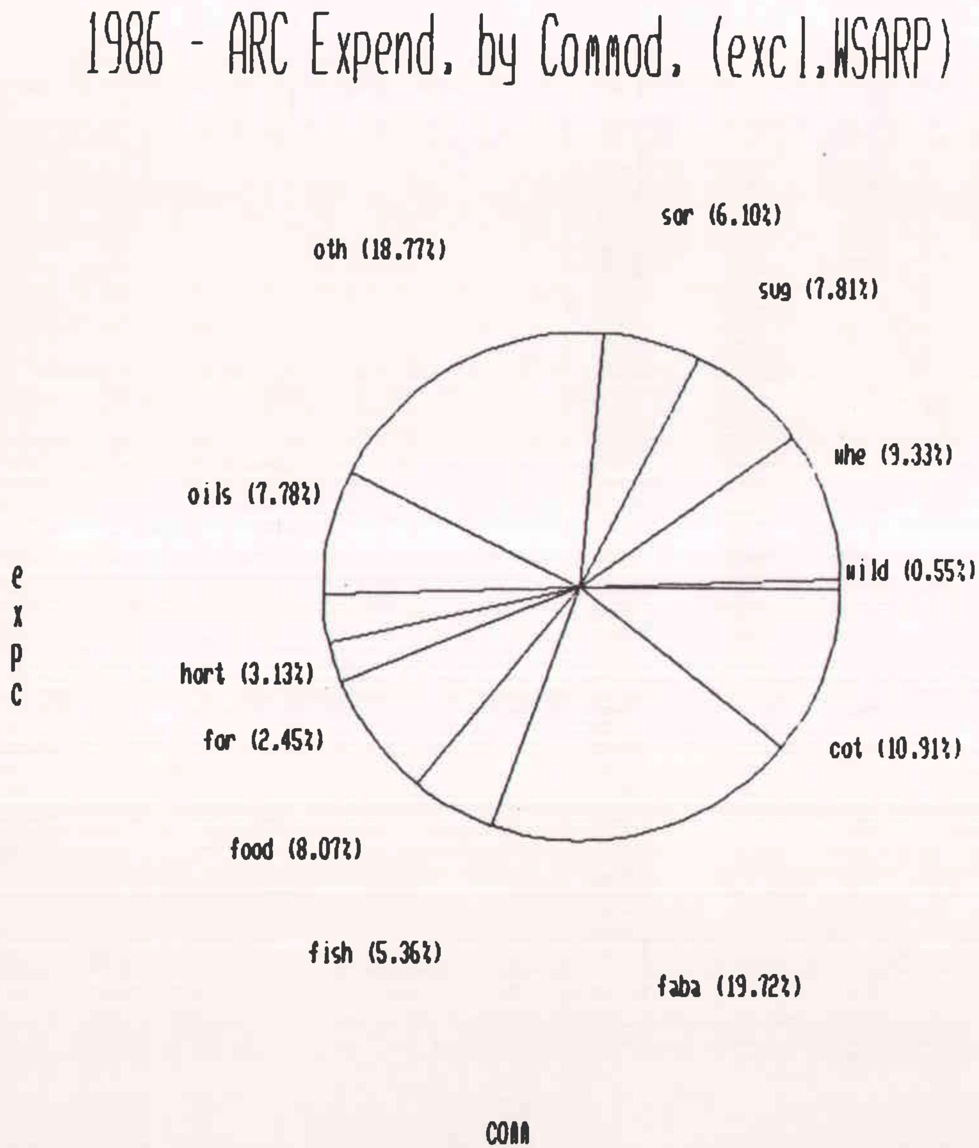

1986 - ARC PhD's and MSc's By Commodity
26
24
22
20
18
16
14
12
10
8
6
4
2
0
cot
faba
fish
food
for
hort
oils
sor
sug
whe
wsarp
COMM
docc
masc

FIGURE 7


1986 - ARC Expend. by Commod. (excl.WSARP)
oth (18.77%)
sor (6.10%)
sug (7.81%)
whe (9.33%)
oils (7.78%)
wild (0.55%)
hort (3.13%)
for (2.45%)
cot (10.91%)
food (8.07%)
fish (5.36%)
faba (19.72%)
expc
comm

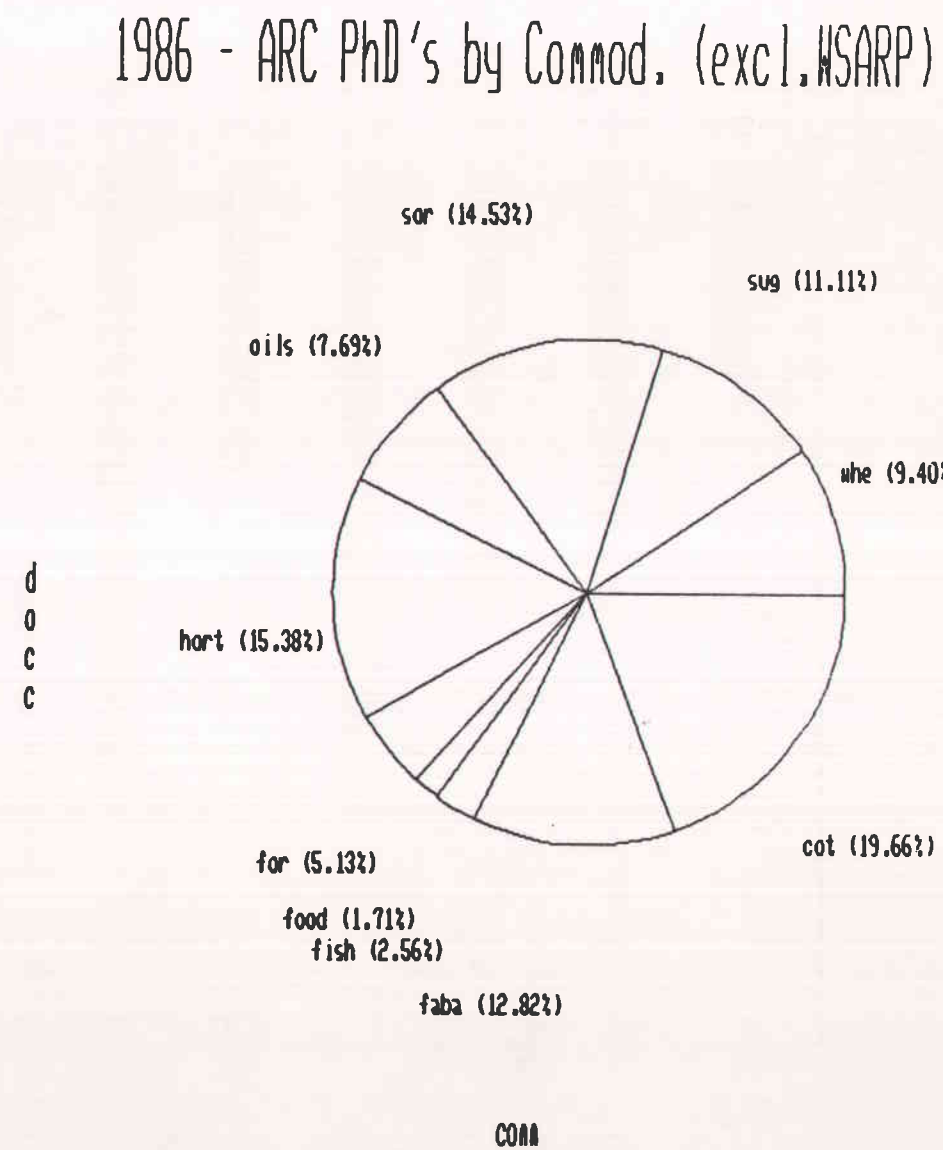

1986 - ARC PhD's by Commod. (excl.WSARP)
sor (14.53%)
sug (11.11%)
oils (7.69%)
whe (9.40%)
hort (15.38%)
cot (19.66%)
for (5.13%)
food (1.71%)
fish (2.56%)
faba (12.82%)
docc
comm

FIGURE 8

ARC - Expenditures by Crop (excl.Faba)

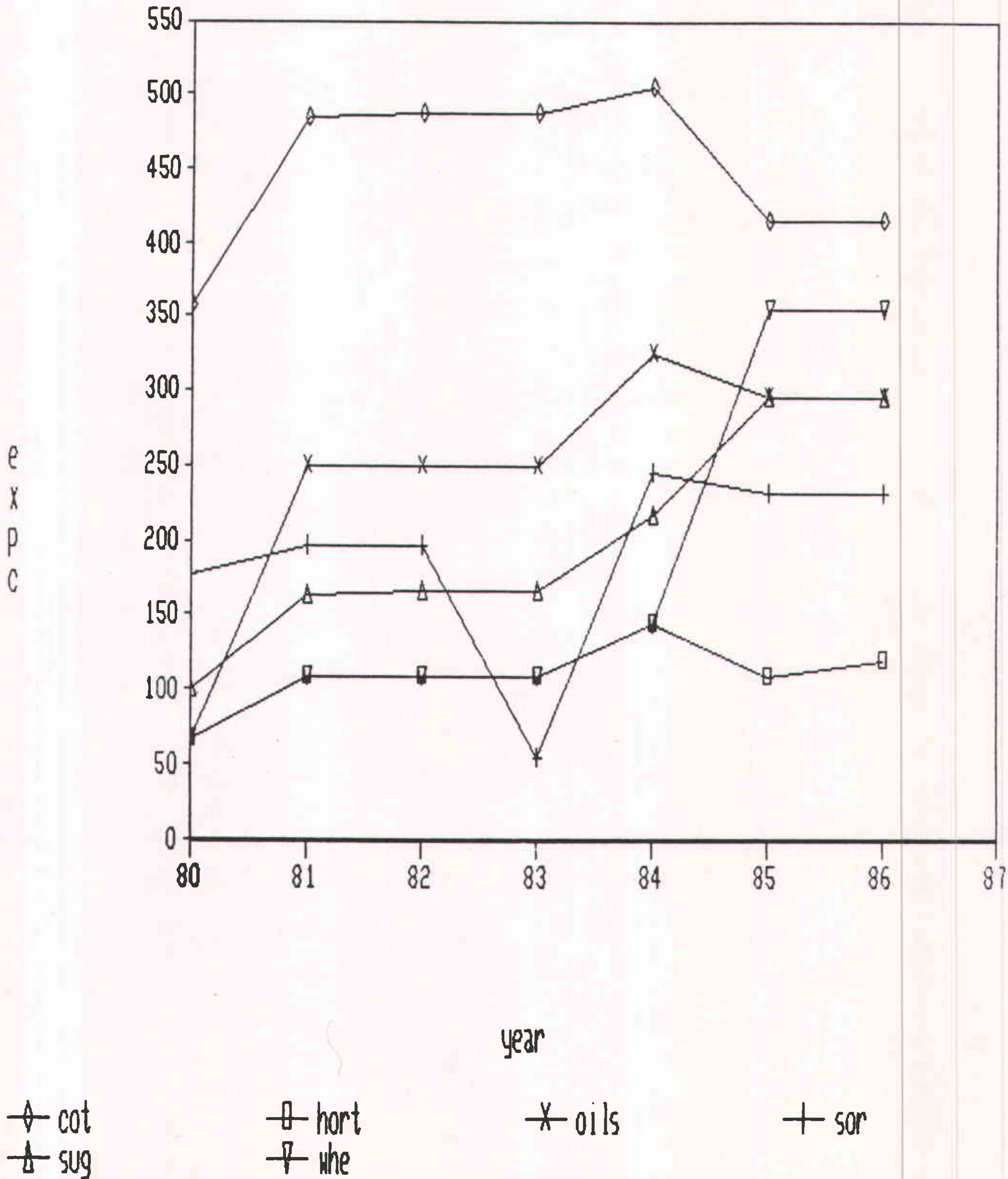
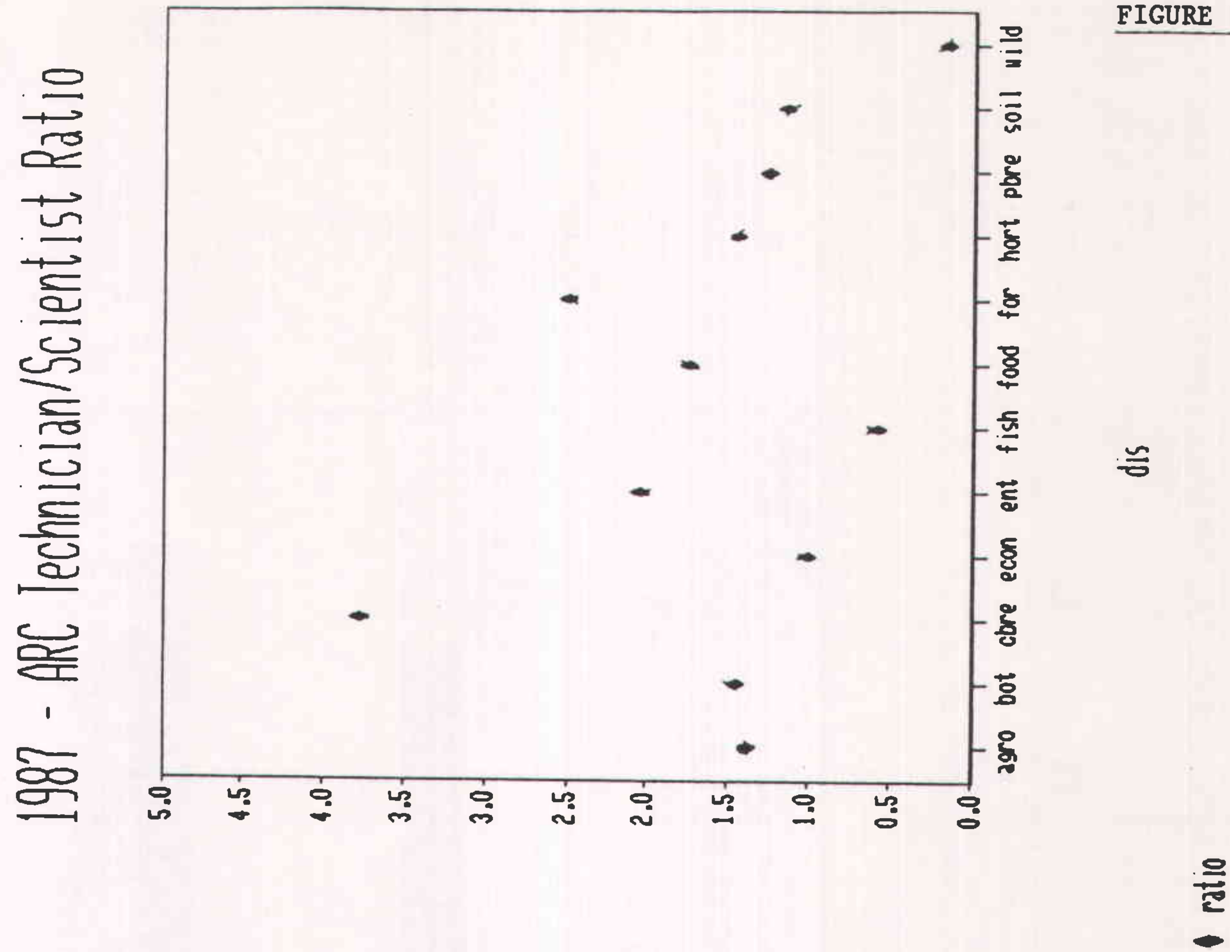


FIGURE 9


1987 - ARC Technician/Scientist Ratio
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
agro bot cbre econ ent fish food for hort pbre soil wild
dis
ratio

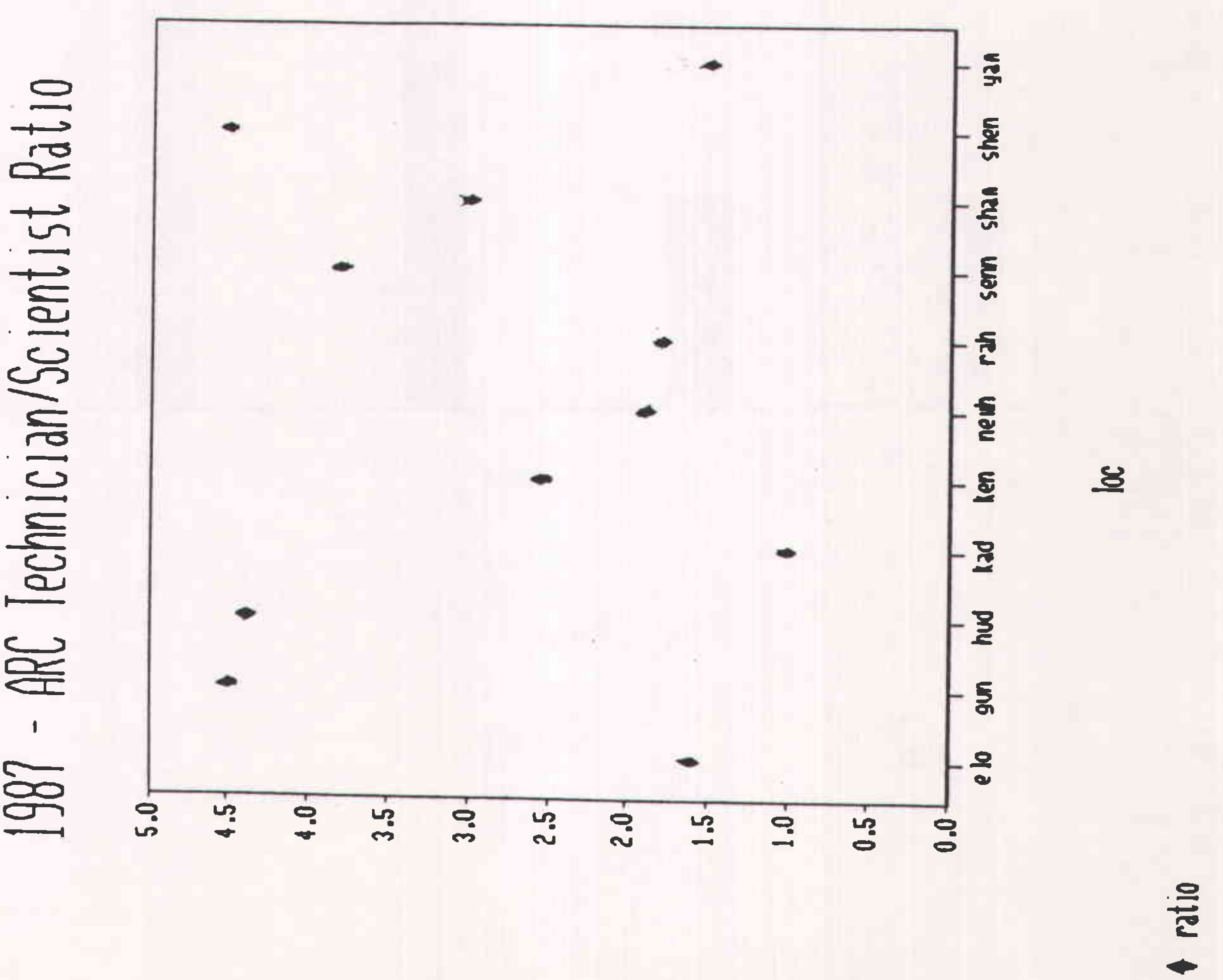
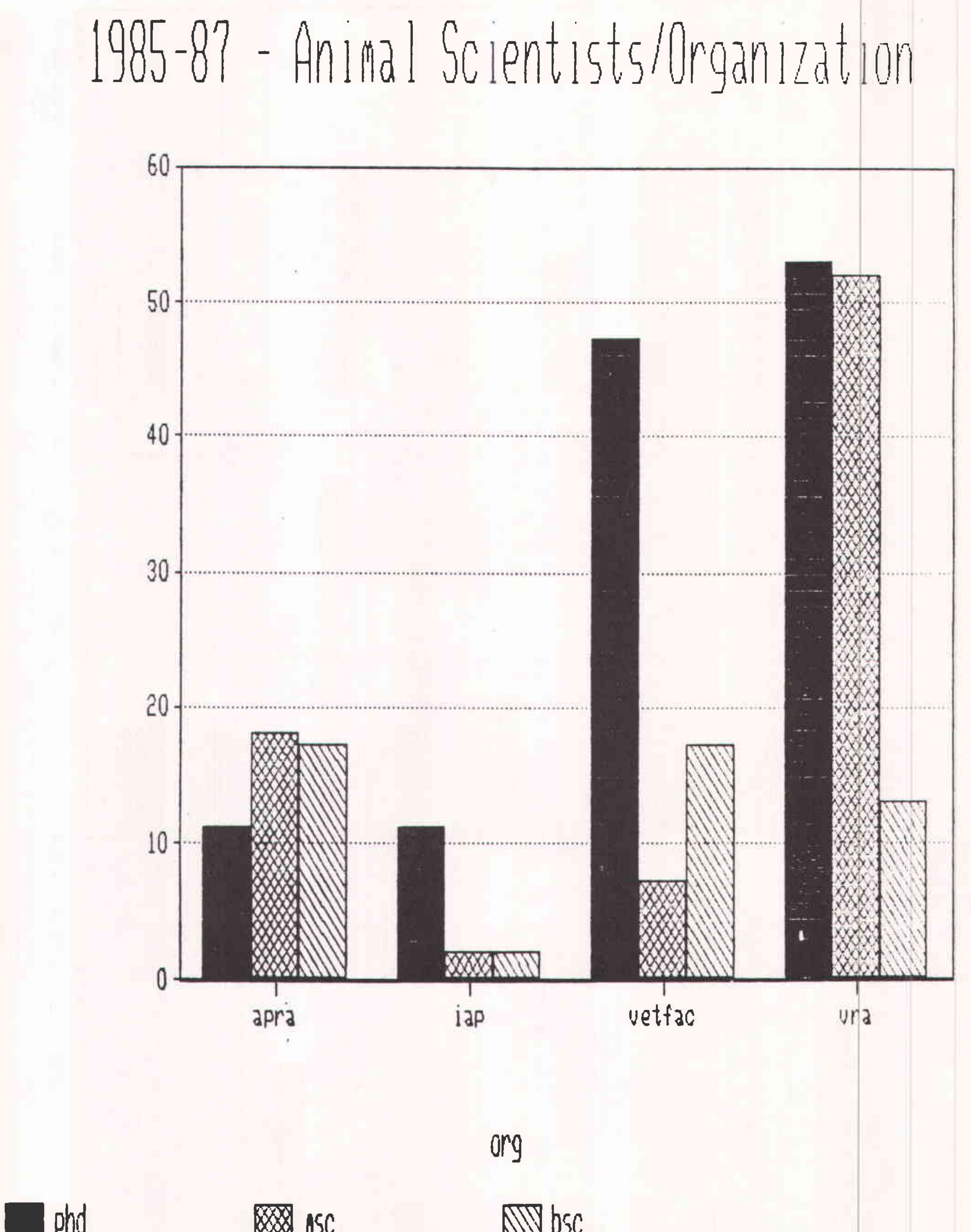

1987 - ARC Technician/Scientist Ratio
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
elo gun hud kad ken newh rah senn shan shen yan
loc
ratio

FIGURE 10


1985-87 - Animal Scientists/Organization
60
50
40
30
20
10
0
apra
iap
vetfac
vra
org
phd
msc
bsc

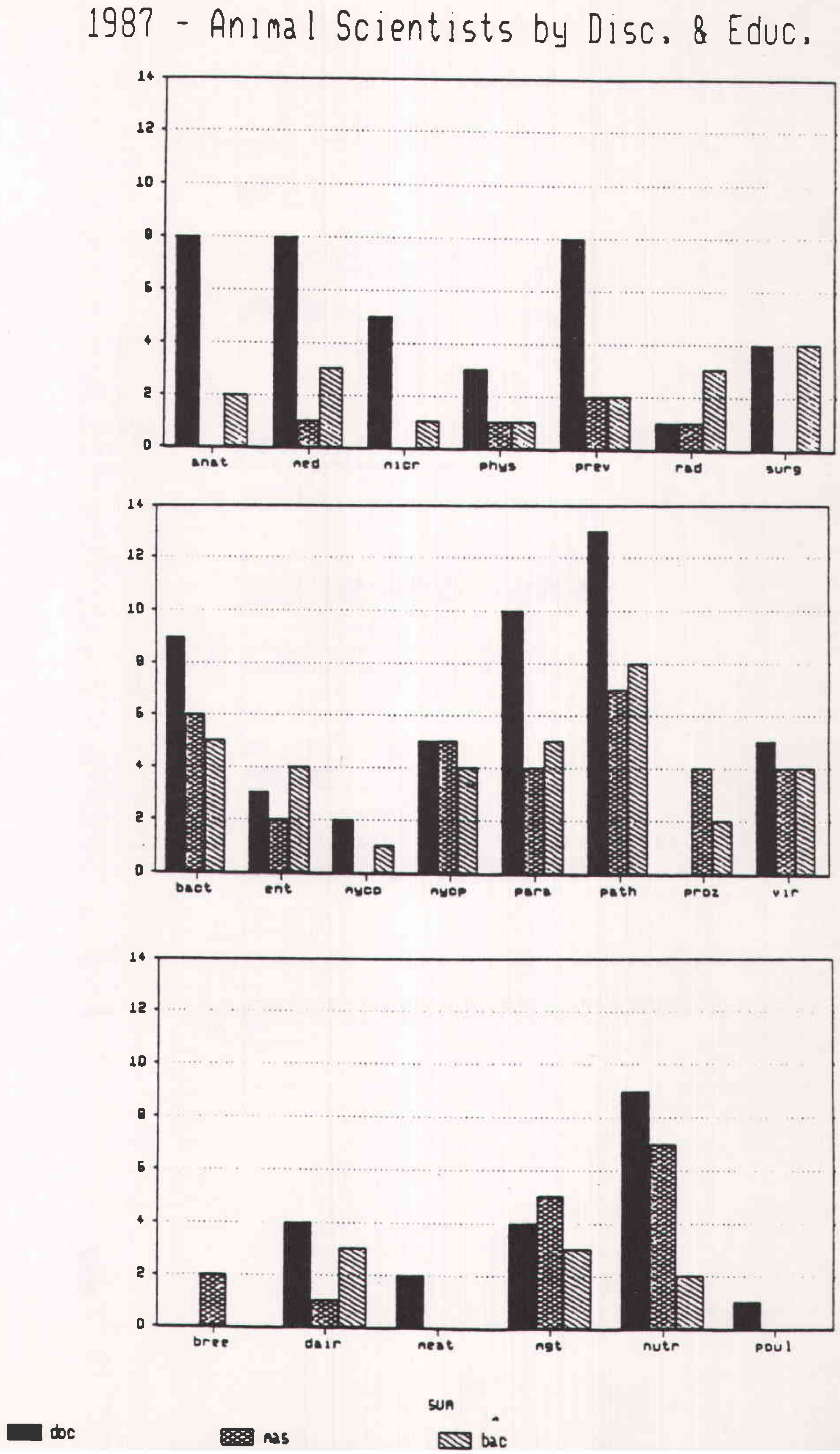
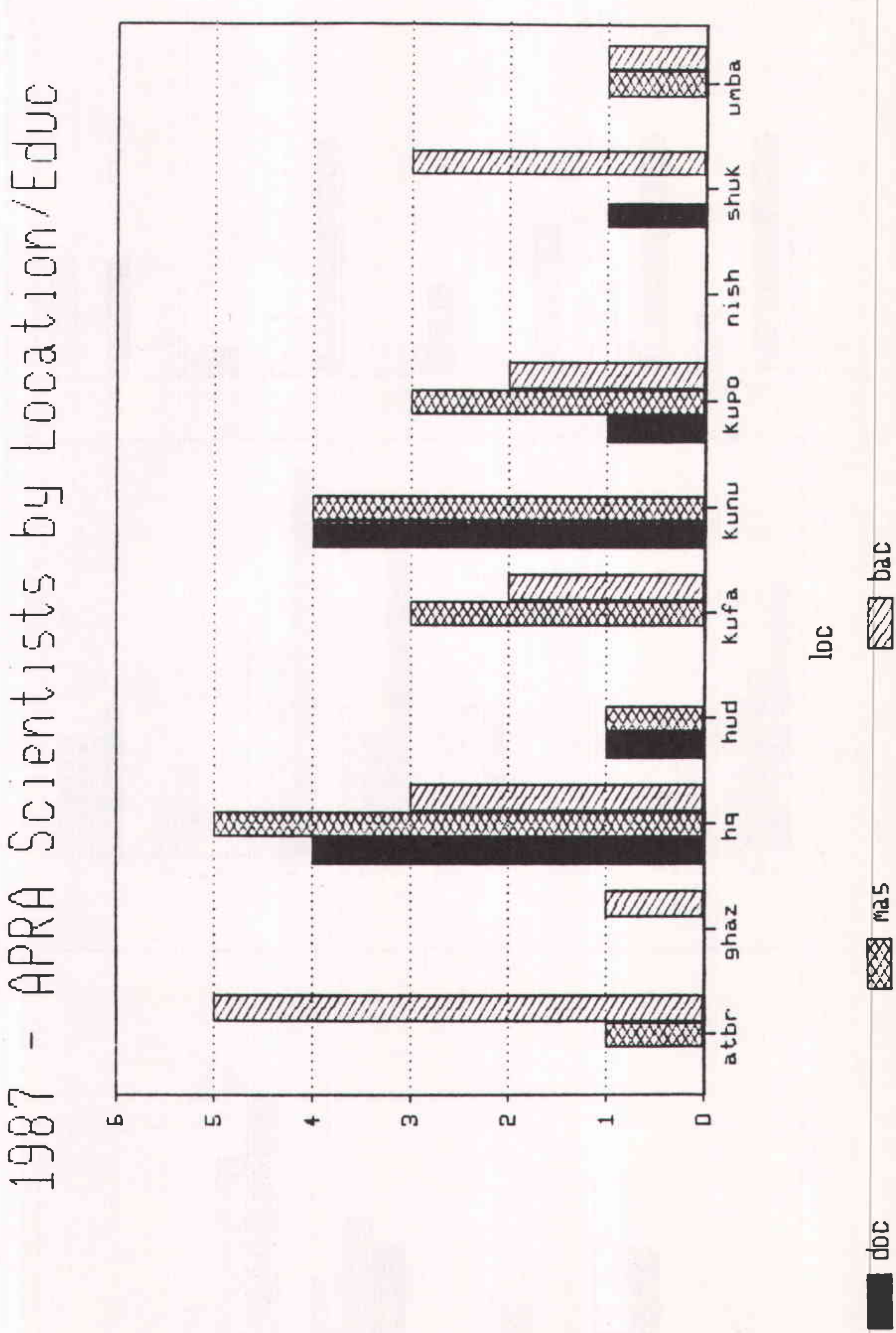

1987 - Animal Scientists by Disc. & Educ.
14
12
10
8
6
4
2
0
anat
med
micr
phys
prev
rad
surg
bact
ent
myco
mycp
para
path
proz
vir
bree
dair
meat
mgt
nutr
poul
SUM
doc
mas
bac

FIGURE 12



1987 - APRA Scientists by Location/Educ
0
1
2
3
4
5
6
atbr
ghaz
hq
hud
kufa
kunu
kupo
nish
shuk
umba
loc
doc
mas
bac

FIGURE 13

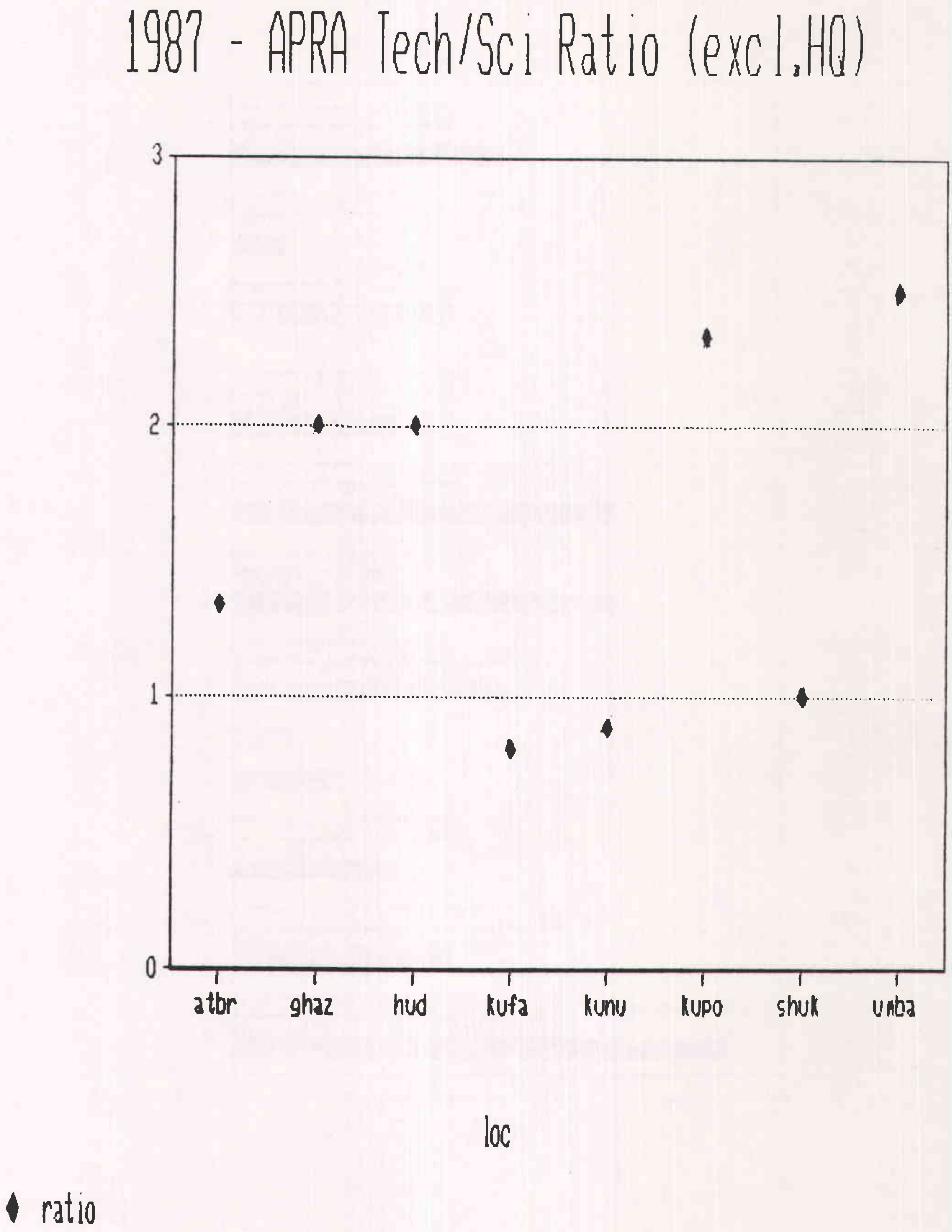

1987 - APRA Tech/Sci Ratio (excl.HQ)
3
2
1
0
atbr
ghaz
hud
kufa
kunu
kupo
shuk
umba
loc
ratio

FIGURE 14

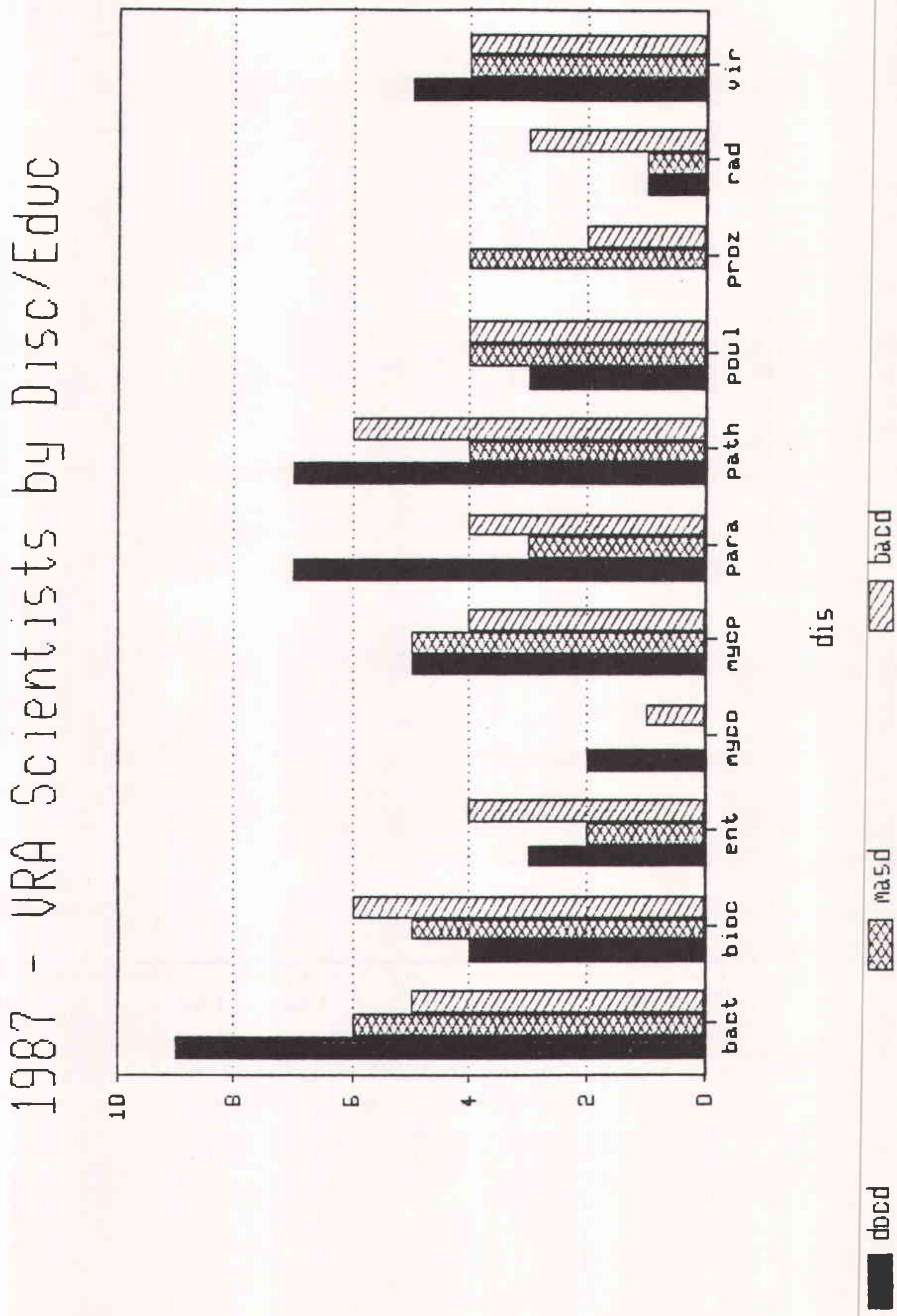

1987 - VRA Scientists by Disc/Educ
10
8
6
4
2
0
bact
bioc
ent
myco
mycp
para
path
poul
proz
rad
vir
dis
dbcd
masd
bacd

FIGURE 15

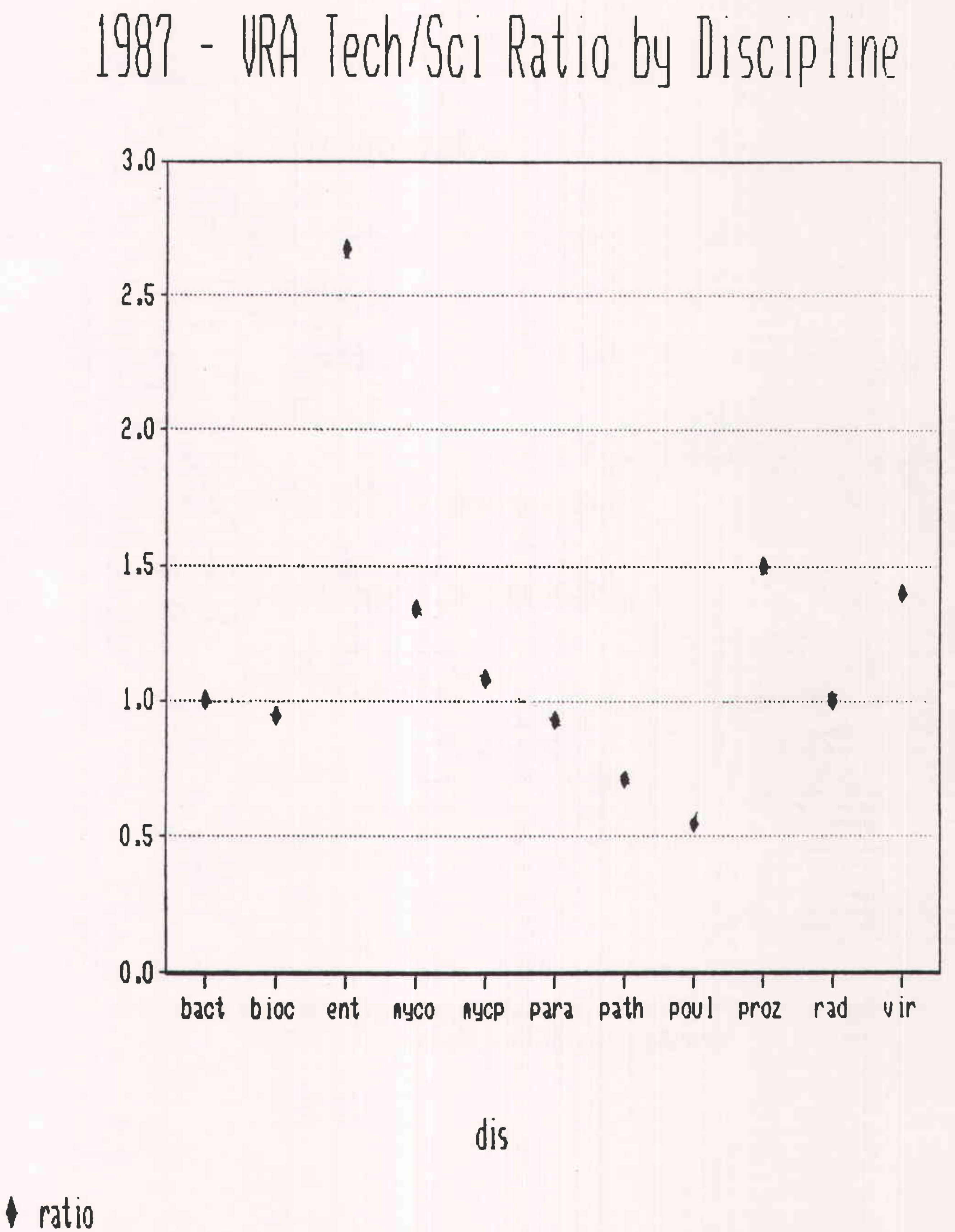
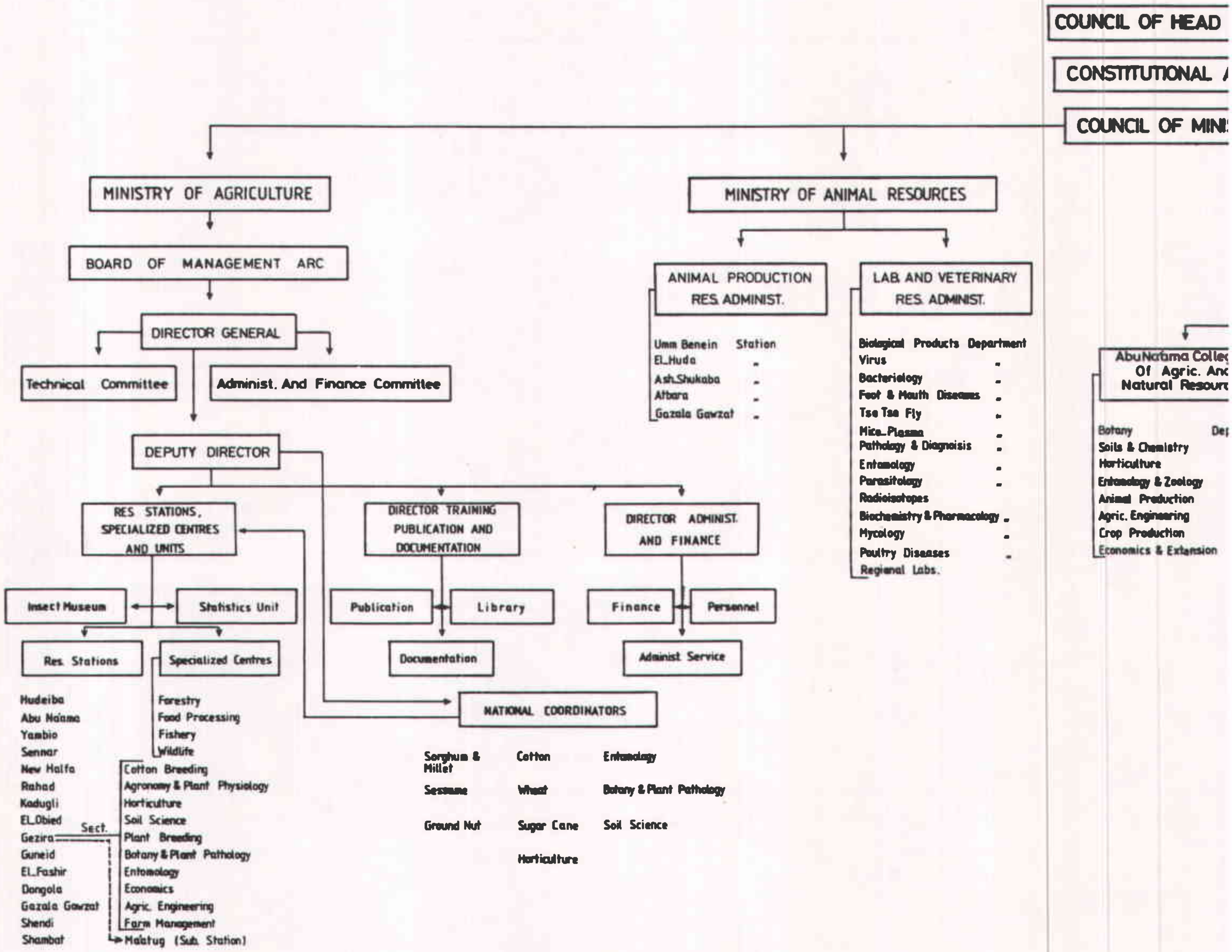

1987 - VRA Tech/Sci Ratio by Discipline
3.0
2.5
2.0
1.5
1.0
0.5
0.0
bact
bioc
ent
myco
mycp
para
path
poul
proz
rad
vir
dis
ratio

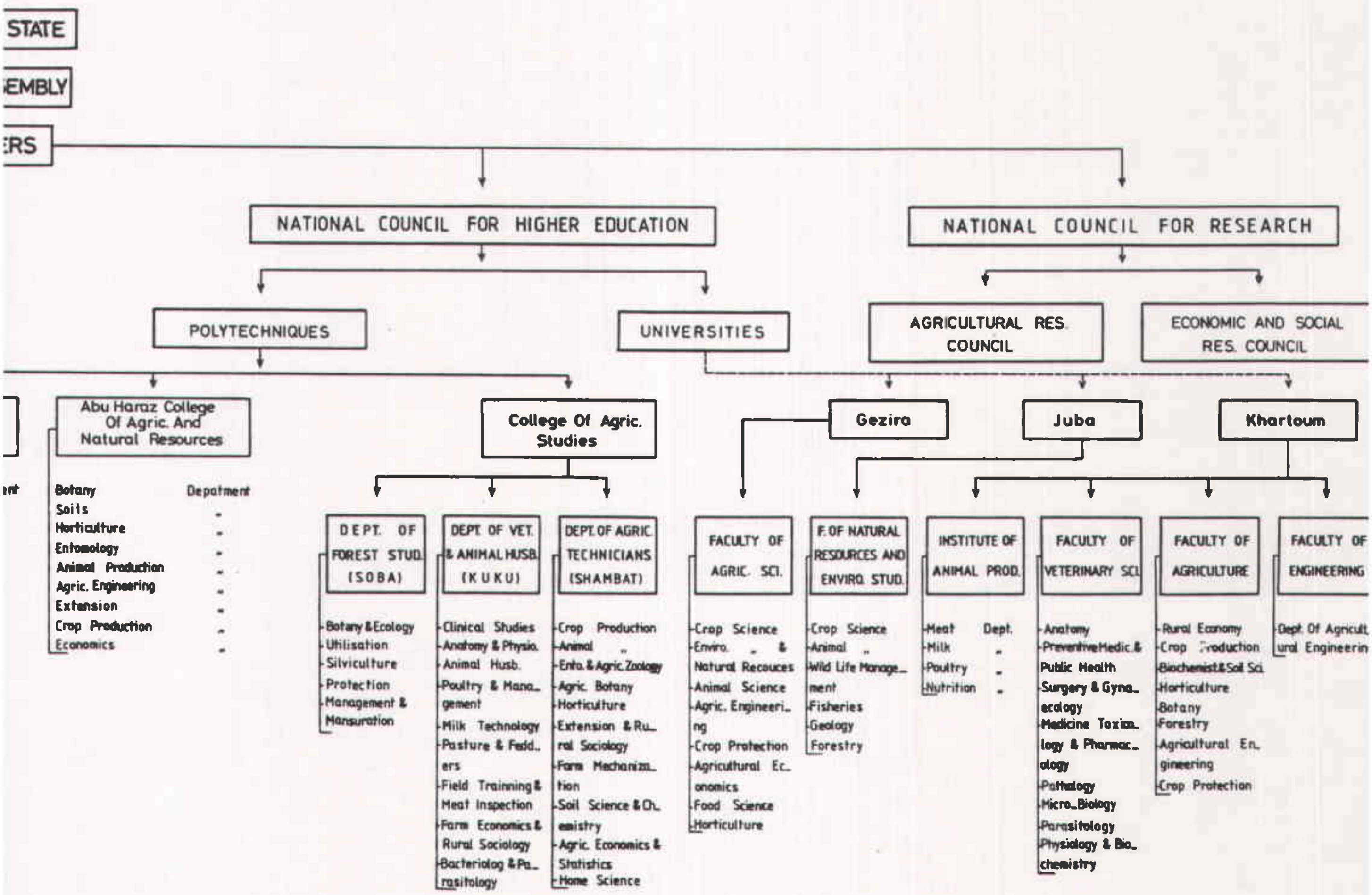
CHART I

ORGANIZATIONAL STRUCTURE OF

RESEARCH SYSTEM IN



IONAL AGRICULTURAL
E SUDAN



Part IV

Human Resources

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PART IV

HUMAN RESOURCES - THE SUDAN 1987

Introduction

It has been posited that the rate of development of science, technology, and even social institutions is determined by human resources. As such, one of the most critical functions of a national scientific research system is the development, retention and continued motivation of a body of competent scientific professionals. As it is these human resources, in the form of scientists, who provide the expertise and knowledge for development, it is then necessary to examine the scientists themselves in order to understand the research enterprise.

While information on scientists and the scientific enterprise has been somewhat meager for the West-Asia, North Africa (WANA) area, growth in scientific staff numbers has been substantial in those countries for which documentation is available. Several examples are as follows: Morocco, the total number of scientists almost doubled, from 127 to 228, from the early 1960s to 1984, with the expatriate community entirely replaced by Moroccan nationals; Egypt, the total number of scientists increased from 1780 to 5000 from 1970 to 1985; Syria, the total number of scientists increased from 15 to 505 from 1969 to 1983.

As is evidenced in Table 1.1, there are several AOAD member countries that have established the critical mass of scientists necessary for a research endeavor: Algeria, 267; Syria, 503 (excluding expatriates); Egypt, 4181; Iraq, 542; Morocco, 226; and Sudan, 204. Of those countries having a critical mass of scientists, The Sudan has trained the highest percentage of Ph.D.s (59.8%), followed by Jordan (29.6%), Egypt (22.6%), Iraq (17.2%) and Algeria (14.2%).

Interpretation and comparison of expenditure data is difficult, as size, relative wealth of oil-exporting countries, donor contributions, and other factors confound the data (Table 1.1).

The Sudan Case

Despite these area informational problems, a quite complete set of information has been collected on the Agricultural Research Corporation (ARC) in the Sudan. Information displayed in Table 1.2 indicates a steady, sustained growth in the number of professionally trained agricultural researchers, from 79 in 1970 to 271* in 1987. In addition to the ever-increasing numbers of scientists, as noted above, the incidence of Ph.D.s has remained high.

---

* Note: this figure differs from Table 1.1, as it includes secondment, education leave, etc.

Table 1.1: AOAD Members and Selected Statistics - Various Years

COUNTRY	Total Ag. Scientists	Total PhD's	% PhD	Exp. (US$) (Mill)	Exp. Per Scientist	Exp. Per PhD	Pop. (Mill) (1985)	Exp. Per Cap	PhD Per Pop. (Mill)
Jordan (1982)	54	16	29.6	.859	15,907	53,688	3.5	.25	4.6
UAE (1983)	2	0	0	1.406	703,000(1)	-	1.4	1.00	-
Bahrain (NA)	NA	-	-	-	-	-	-	-	-
Algeria (1985)	267	38	14.2	NA	-	-	21.9	-	1.7
Djibouti	NA	-	-	-	-	-	-	-	
Saudi Arabia (1983)	94	2	2.1	NA	-	-	11.5	NA	.2
Syria (1983)	502	44	8.8	5.814	11,581	132,136	10.5	.55	4.2
Somalia (1983)	30	NA	NA	.180	6,000	-	5.4	.03	-
Iraq (1983)	542	93	17.2	NA	-	-	15.9	-	5.8
Oman (1983)	10	1	10.0	NA	-	-	1.2	-	.8
Palestine	NA	NA	NA	NA	-	NA	NA	NA	NA
Qatar (1983)	6	0	0	1.746	291,000	0	.315	5.54	0
Kuwait (1983)	1	0	0	-	-	-	1.7	NA	0
Lebanon	NA	NA	NA	NA	-	-	NA	NA	-
Libya	NA	NA	NA	NA	-	-	3.8	NA	-
Egypt (1983)	4181	944	22.6	23.961	5,731	25,382	48.5	.49	19.5
Morocco (1983)	226	4	1.8	18.139	80,261	4,534,750	21.9	.83	.2
Mauritania (1983)	12	7	58.3	.449(1982)	37,416	64,143	1.7	.26	4.1
Arab Rep. of Yemen (1980)	12	0	0	NA	-	-	8.0	NA	0
Peo.Dem.Rep. of Yemen (1983)	70	8	11.4	1.204	17,200	150,500	2.1	.57	3.8
Tunisia (1985)	129	NA	NA	NA	-	NA	7.1	NA	-
Sudan (1983)	204	122	59.8	8.154	39,970	66,836	21.9	.37	5.6

(1) High expenditure rate due to expatriates not being in calculation - with expatriates it is $116,667/yr.

Table 1.2: Sudan-ARC 1970-1987

YEAR	D E G R E E				
	Ph.D.		M.Sc.	B.Sc.	Total
1970					79
1972					74
1977	-	112	-	54	166
1978	-		-	-	-
1979	-	123	-	38	161
1980	-		-	-	-
1981	104		60	54	218
1982	-		-	50	200
1983	122		51	29	202
1984	-		-	-	-
1985	145		35	24	204
1986	129		68	51	248
1987	125		65	80	271

While documentation was not available on the growth of 12 other organizations involved in agricultural research, statistics on educational levels and support in these organizations was gathered with the institutional questionnaire. As can be seen in Table 1.3, in total there are 875 professional agricultural scientists in the Sudan. Of this 875, 43% are Ph.D.s. In addition to the 43%, 94 individuals (classified as post graduates) are presently being trained in Ph.D. programs. Thus, in total, 471 agricultural scientists have or soon will have Ph.D.s.

In regard to technical support, in all organizations there are a total of 974 technicians, or 1.1 per scientist. 548 of these 974 technicians are in the ARC, thus providing the ARC scientists with over 2 technicians per scientist.

In total, there are 7151 individuals involved in the agricultural research effort in the Sudan, with the majority of these, 4230, in the ARC.

The Methodology

Recognizing that there is a critical mass of agricultural scientists within the ARC as well as in other organizations, it was determined to include a human resource inventory questionnaire in the ATMS package. The purpose of the questionnaire was to collect as comprehensive data as possible about quality and quantity of staff, so that a more complete understanding of the research enterprise could be gained.

Specifically, there were four major themes that were considered as warranting attention:

Table 1.3: Sudan Agricultural Research Human Resources - 1987

	PhD	MSc	BSc	Post Graduate	Total Scientists	Technical Support	Administrative Support	Other	Total
Agricultural Research Corporation	125	66	49	31	271	548	302	3109	4230
College of Agricultural Studies Khartoum Polytechnic	14	30	8	7	59	36	61	323	479
Abu Haraz College of Agriculture	1	16	6	3	26	13	11	110	160
Abu Naama College of Agriculture	3	18	-	3	24	5	1	150	180
Economic and Social Research Council	7	8	1	5	21	1	7	-	29
Agricultural Research Council	4	2	4	-	10	-	6	-	16
Animal Production Research Administration	11	18	17	4	50	48	27	457	582
Institute of Animal Production	11	2	2	6	21	10	8	27	66
Faculty of Veterinary Science	47	7	17	-	71	78	19	120	288
Veterinary Research Administration	45	39	43	24	151	165	18	192	526
Faculty of Agriculture University of Khartoum	60	1	34	-	95	42	28	147	312
Department of Agricultural Engineering, University of Khartoum	1	1	3	4	9	1	1	-	11
Faculty of Agriculture University of Gezira	48	7	5	7	67	27	8	170	272
Total	377	215	189	94	875*	974	497	4805	7151

* There are also 8 expatriate scientists

- the considerations involved in assessing the adequacy of current scientific staff;
- data for estimating future needs;
- planning necessary in career training;
- creating conditions of service which motivate scientists to perform to their fullest capacities.

To respond to these themes, a sample questionnaire was proposed. It was suggested that modifications be made, as appropriate, in order to generate information about issues unique to the country. The sample questionnaire included: background information; education; and employment as the general categories. Thus, the information to be analyzed was: demographics; educational characteristics of scientists and administrators; and career histories, including function, location, remuneration, and opportunities.

The Sudan team utilized the questionnaire without modifications as it had been presented in the SARMAC document. The organizations to be surveyed were distributed to the various Sudan team members and ultimately, 589 questionnaires were sent to 5 major organizations or categories of organizations in which agricultural research is accomplished. A letter urging cooperation from both the Minister of Agriculture and the Director General of AOAD accompanied each questionnaire. Additionally, 20 temporary staff people were hired to assist the process. The following table (Table 1.4) indicates the effort and success rate of the collection exercise.

Table 1.4: Human Resource Inventory - The Sudan 1987

Major Organizations	Number of Questionnaires		
	Sent	Returned	%
Agricultural Research (Crops)	206	181	88
Polytechnic Institutes	80	48	60
National Research Council	14	9	64
Animal Production and Vet Research (1)	5	5	100
Universities (2)	184	129	70
TOTAL	489	372	76

(1) This does not include the Soba Veterinary Research Laboratory, as of the 100 questionnaires sent, only 12 were completed.

(2) This does not include the 25 questionnaires from the University of Juba.

The Findings - Scientific Community Description

According to Table 1.5 Selected Indicators, the average age of the Sudanese agricultural researchers is 38. This does not vary significantly across the 5 institutions or groups of institutions. The overwhelming majority (94%) of the agricultural researchers are male. The distribution across age categories (<25, 25-34, 35-44, 45-54, 55-64, 65+) is bell-shaped, with 97% of the researchers between the age of 25 and 54. This type of distribution occurs in all the organizations.

In terms of educational attainment, the majority of the agricultural researchers in the survey hold Ph.D.s (61%), with master's attainment second (29%) (Table 1.6). The largest number of highest-degree holders was in the universities, where 82% of the faculty members responding to the questionnaire held Ph.D.s.

In regards to the scientific disciplines (Table 1.7), the larger organizations, i.e., ARC and the universities, had representation in the complete array of educational specialities. As would be expected, the largest cohort at the ARC is plant science, and at the universities it is animal science. Several anomalies became apparent as scientists were classified in this manner: 1) Approximately one quarter of the ARC staff is involved in nutrition and food processing, as 41 of the 181 respondents were in this second largest cohort. While this is a need and a high-priority item for the Ministry of Agriculture, it was hypothesized by ARC officials that this over-representation is a function of a donor-driven educational policy; 2) Despite the size, sophistication, and complexity of the various organizations, no one has obtained a degree in administration; 3) Despite the high quality and importance of the research, and the mission to work with farmers for development, only 2 scientists have received degree training in Education/Extension/ Information communications.

It should be noted that this lack of personnel trained in extension may be a function of the placement of extension within the ministry system. Given the widely diffused nature of the extension service organizationally, the paucity of statistics may not be an appropriate reflection of the capabilities, but rather of organizational placement of the individuals. As the primary assignments of extension workers is to the National Extension Administration, NEA, and to the production schemes, they were not recipients of the survey instrument and thus are not adequately represented.

In order to review organizational maturity and identify experience gaps, the institutional survey requested information on scientists' years of experience. The information on years of experience by institution appears in Table 1.8. The distribution of years of research experience within organizations appears to be a good mix of experience (15+) and younger scientists. In those organizations where there could be a danger of losing a critical mass due to aging or expatriation, i.e., the ARC and veterinary organizations, it should be noted that Table 1.3 indicates that 31 ARC personnel and 24 VRA personnel are presently being trained.

Table 1.5: Sudan Agricultural Research Community
Selected Indicators 1987 n = 372

Institution	No. of Researchers	Average Age	Male	Female	Number of Researchers in Age Category <25	25–34	35–44	45–54	55–64	65+
Agricultural Research Corporation	181	38	164	17	2	52	91	33	3	0
Animal Production	5	36	5	0	0	2	3	0	0	0
National Research Council	9	38	8	1	0	1	8	0	0	0
Polytechnical Institutes	48	38	47	1	0	14	28	6	0	0
Universities	129	39	124	5	0	30	70	24	4	1
Total	372	38	(94) 348	(6) 24	(.5) 2	(27) 99	(54) 200	(17) 63	(2) 7	(.3) 1

Table 1.6: Sudan Agricultural Research Community
by Degree by Institution - 1987 (n = 372)

Institution	Number of Researchers	n, % holding					
		Ph.D.		M.Sc.		B.Sc.	
		n	%	n	%	n	%
Agricultural Research Corporation	181	102	56	57	31	22	12
Animal Production	5	2	40	2	40	1	20
National Research Council	9	5	55	4	44	0	0
Polytechnical Institutes	48	10	20	33	68	5	10
Universities	129	107	82	11	8	11	8
	372	226	61	107	29	39	10

Table 1.7: Sudan Agricultural Research Community
Educational Discipline By Institution
1987 n = 372
Educational Discipline

	Total n	General Ag	Ed/Ext/ Info	Admin	Ag Ec, Devel, RS	Plant Science	Plant Protection	Ento	Forestry	An Sci	Fish	Ag Mech	Nut	Food
Agricultural Research Corporation	181	4	0	0	12	66	20	14	6	8	4	6	26	15
Animal Production	5	1	0	0	0	0	0	0	0	4	0	0	0	0
National Research Council	9	2	0	0	4	0	2	0	0	1	0	0	0	0
Polytechnical Institutes	48	1	2	0	2	8	5	3	5	11	0	4	7	0
Universities	129	3	0	0	5	20	11	3	7	50	0	15	9	6
Total	372	11	2	0	23	74	38	20	18	74	4	25	42	21

Table 1.8: Years Experience of Scientists by Institutuion - The Sudan 1985

ORGANIZATION	RESEARCH EXPERIENCE (Years)				
	0 - 2	3 - 5	6 - 10	11 - 15	15+
Agricultural Research Corporation	31	31	39	39	90
College of Agricultural Studies Khartoum Polytechnic	NA	NA	NA	NA	NA
Abu Haraz College of Agriculture and Natural Resources	NA	NA	NA	NA	NA
Abu Naama College of Agriculture and Natural Resources	1	11	5	3	0
Economic and Social Research Council	0	1	7	3	0
Agricultural Research Council	NA	NA	NA	NA	NA
Animal Production Research Administration	15	8	10	7	6
Institute of Animal Production	NA	NA	NA	NA	NA
Faculty of Veterinary Science	9	14	5	17	20
Veterinary Research Administration	0	14	42	30	41
Faculty of Agriculture University of Khartoum	17	16	32	19	11
Department of Agricultural Engineering, University of Khartoum	0	0	1	0	0
Faculty of Agriculture University of Gezira	NA	NA	NA	NA	NA
Total	71	95	141	118	168

In the classification of time spent on the various activities, research, administration, training, extension, and travel/conferences, (Table 1.9) the individual's prioritization was consistent with the organizational mission. Thus, for example, the most important activity at the Gezira Research Station was research, and training and research were relatively equal activities at the universities.

When requested to describe the nature of training that was required to achieve career objectives, most of the requests were for training that was not available in the country. Of the 434 requests made, 74 were for long-term Ph.D. training. Most of these requests were from the ARC and polytechnic Institutes. This clearly was in recognition that higher education was essential to advancement within these organizations. Most of the short-term training requests were for very specific, topical issues not available within the Sudan.

In regards to indicators of professionalism, the scientists listed publications, membership in professional societies, awards received, and meetings attended. As is evidenced in Table 1.10, a surprizingly high percentage of scientists indicated publications and the average per publisher was high. While this statistic was due somewhat to the lack of definition of "publication" and timeframe, it nevertheless indicates an active group of professionals, as 66% listed some type of publication. Active participation in a professional society was also very high, as 70% of the scientists indicated some kind of membership, with many indicating more than one. Meeting attendance was high, 61%, with many indicating multiple meetings. Receipt of awards was also high, as 33% indicated they had received awards.

Four Major Themes

In the methodology section, four themes were enumerated which were considered as warranting attention with the human resource inventory: adequacy of current scientific staff; future needs; planning for in-career training; and conditions of service which motivate staff. The following paragraphs briefly describe the findings of the human resource survey with respect to the themes.

Theme 1: Adequacy of the Current Scientific Staff

As was evidenced in Tables 1.1, 1.2, and 1.3, the Sudan has a relatively large, well-trained cadre of agricultural scientists. The scientific community has experienced a sustained growth phase, and apparently will continue to do so. There is adequate technical and administrative support, particularly in the ARC. The range of age and years of experience across organizations and scientific discipline is evenly distributed, according to Tables 1.5 and 1.7. Regarding Professional Indicators, as described in Table 1.10, the scientific community appears to be active in publications, society membership, meetings, and receipts of awards.

Areas of concern or future study are as follows:

1) The lack of academic expertise in administration and information/ extension needs to be addressed.

Table 1.9: Sudan Agricultural Research Community 1987
n = 372
- % of Time Spent on -

		Research	Administration	Training	Extension	Travel/Conferences
Agricultural Research Corporation (Gezira)	(n = 65)	77	10	6	1	2
National Research Council	(n = 6)	77	16	2	0	3
	(n = 3)	23	60	10	1	5
Polytechnical Institutes	(n = 9)	14	27	50	6	1
	(n = 6)	18	25	52	0	3
	(n = 10)	16	25	41	13	4
	(n = 15)	12	23	55	6	3
	(n = 8)	1	18	76	2	1
Universities	(n = 5)	61	15	20	0	2
	(n = 56)	35	10	43	7	3
	(n = 34)	35	15	40	4	4
	(n = 11)	42	13	33	9	2
	(n = 23)	33	10	48	4	4

Table 1.10: Professional Indicators - The Sudan 1987

	'n' Scientists	Publications Yes	%	No	%	No. of Publications	Ave. per Publisher	Professional Soc. Yes	%	No	%	Received Award Yes	%	No	%	Attended Meeting Yes	%	No	%
Agricultural Research Corporation	181	133	73	48	27	1229	9.2	126	70	55	30	69	38	112	62	121	67	60	33
Animal Production	5	4	80	1	20	26	6.5	1	20	4	80	0	0	5	100	1	20	4	80
National Research Council	9	8	89	1	11	39	4.9	6	67	3	33	2	22	7	78	9	100	0	0
Polytechnical Institutes	48	21	44	27	56	64	3.0	30	63	18	37	7	15	41	85	24	50	24	50
Universities	129	79	61	50	39	921	11.7	98	76	31	24	43	33	86	67	72	56	57	44
Total	372	245	66	127	34	2279	9.3	261	70	111	30	121	33	251	67	227	61	145	39

2) While total critical mass of scientists appears adequate there are specific circumstances that should be addressed for the critical important research organizations such as the ARC and VRA.

a) Within the ARC:

- Almost 60% of the capability in the agronomy section has over 10 years of experience. As this is the major disciplinary emphasis within the ARC, it is good that it is also the most experienced. However, it should be noted that presently only 2 individuals are being trained and only 3 have less than 2 years experience. Thus, if the critical mass is to be maintained, more need to be trained.

- Of the seven individuals in Wildlife Research, none has less than 10 years experience. Presently, no individual is being trained in this area. Recognizing the amount of time necessary for training of Ph.D.s, if this expertise is to be maintained at its current level, training should begin immediately.

- Entomology, horticulture, plant breeding, and soil science all have similar profiles. All have very experienced scientists, few are in the younger, less experienced categories, few are being trained presently.

b) Within the VRA:

- Presently no one in the reorganization has less than 3 years of experience.

- A small number (4) are being trained to the Ph.D.

- In the extreme case, mycoplasma, there is only one individual with less than six years of experience and only one individual being trained.

Theme 2: Data for Estimating Future Needs

Briefly, with the exceptions of the examples cited above, the estimations for future needs should be done on an institutional basis, with aggregate data rather than with a partial set of human resource data. Thus the reader is referred to the institutional annex.

Theme 3: Planning Necessary In-Career Training

As was described in the text, there were 434 requests for training that the individual scientists considered necessary in order to achieve their career objectives. Of these, the most common request was for Ph.D. training. Most of the requests were for out-of-country, long-term training. A complete listing of the requests is attached for reference as Table 5: List of Desired Training by Institute.

Theme 4: Conditions of Service which Motivate Staff

In addition to the "mystique" that research is its own reward, there is the belief that the reward structure for agricultural researchers is also basic to the system's ability to attract, retain, and motivate its scientific labor force. It is essential that methods be developed that can provide insight into the reward structure and the actual values that scientists place on the reward. In the following analysis there are comparisons of compensation packages, statistical analysis, and income profiles for the various organizations involved in agricultural research.

First, Figure 1 is a boxplot of the compensation packages for the five groups of institutes involved in agricultural research in the study in the Sudan. The compensation package includes salary, allowance, housing, and premiums as reported by the scientists.

The boxplot is a schematic display of median, quartiles, and outlying data points of a variable. It is useful in identifying ranges and central tendencies of a variable by different subgroups.

A boxplot consists of a box running from the first quartile to the third quartile. The first quartile is the data value that has 25% of the values lower than it, while the third quartile has 75% of the values lower than it. The box contains the median, the point where 50% of the values are on each side. Extending out from the sides of the box are "hinges", which reach one-and-a-half times the distance from the first to the second quartile in each direction from the box - but the hinges never extend beyond the minimum and maximum data values. Any data points falling outside of the hinges are identified by an asterisk.

In Figure 1, the range of compensation packages is from a minimum of 4140 Sudanese pounds to a maximum of 42,570 Sudanese pounds. The median is 18,600. The concentration from 25% to 75% is from 13,788 to 25,638. The statistics are arrayed in Table 1.11, Boxplot Values - Total Compensation Package by Institution.

While it is somewhat interesting to see the range and central tendency for the total group of scientists, it is much more instructive to look at the organizations in isolation, and compare them to one another. Figure 2 provides the visual image of the comparisons and the statistics are listed in Table 1.11. What is immediately obvious is that there is a major difference in compensation packages between the two largest organizations involved in research, the ARC and the universities. The ARC has the lowest median of all 5 organizations at 14,730, only 56% of the median for universities. In fact, Hinge 1 for the universities is higher than the median of the ARC, and the median university package is over 7,000 Sudanese pounds higher than Quartile 3 of the ARC. The maximum compensation package for the universities is almost one-third higher than the maximum of the ARC.

The Sudan 1987

Figure 1

Boxplot of Total Remuneration for All Institutes

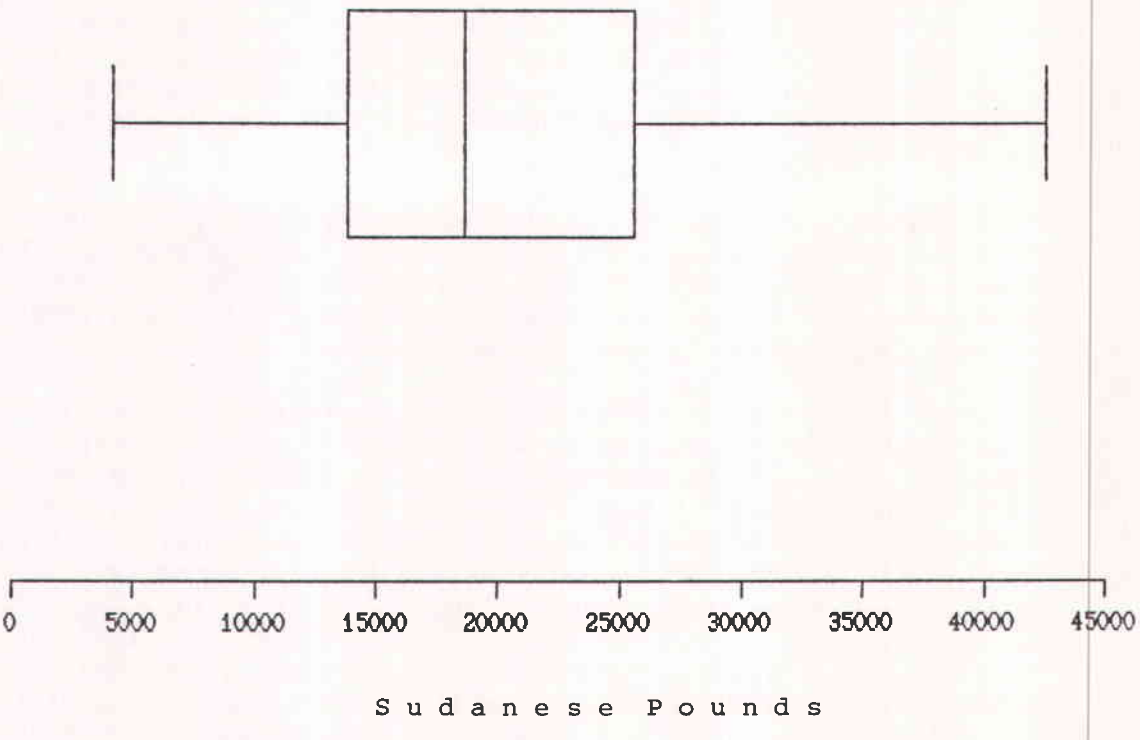


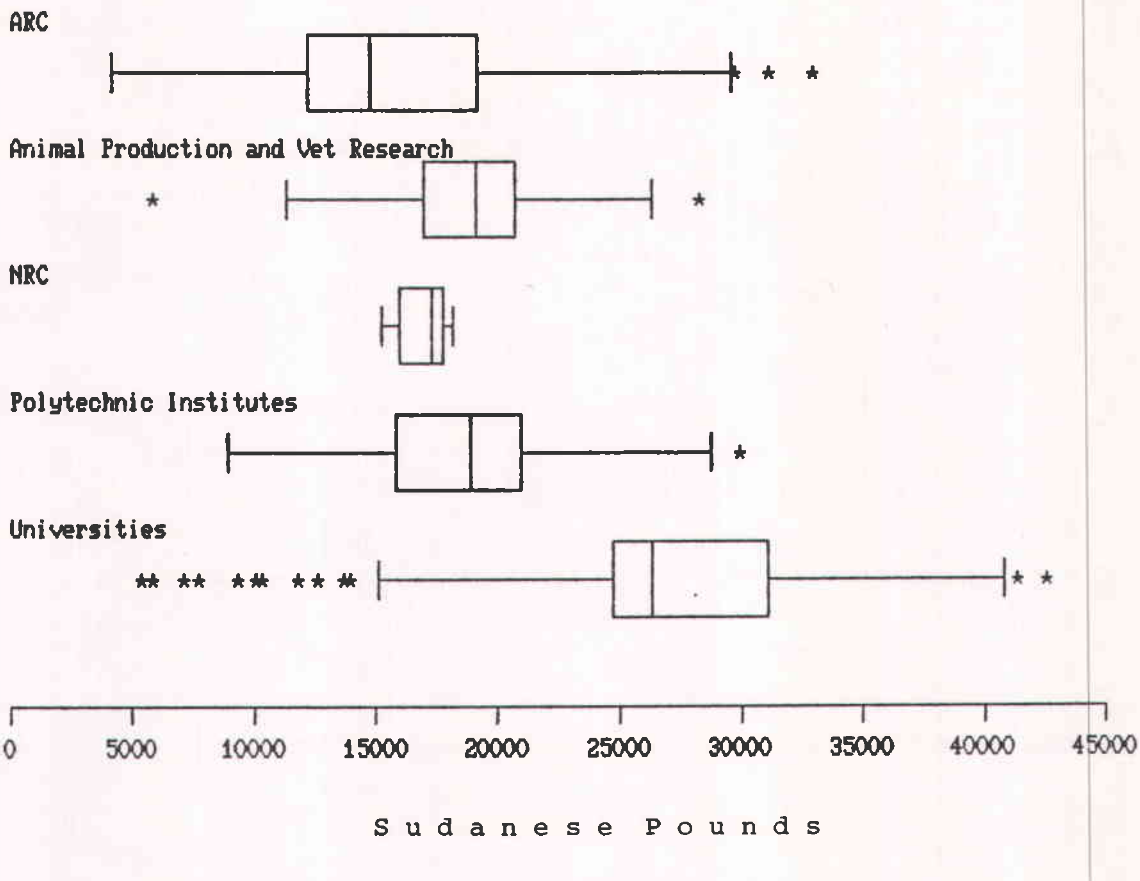
Table 1.11: Boxplot Values - Total Compensation Package by Institution - The Sudan 1987

Institution	n	Minimum	Hinge 1	Quartile 1	Median	Quartile 3	Hinge 2	Maximum
Agricultural Research Corporation	130	4140	4140	12185	14730	19164	29632.5	33000
Animal Production	11	5820	11325	16980	19140	20750	26405.0	28340
National Research Council	7	15200	15200	15972	17292	17750	18200.0	18200
Polytechnical Institutes	29	8964	8964	15834	18882	21000	28749.0	30000
Universities	101	5348	15090	24738	26346	31170	40818.0	42570
TOTAL	278	4140	4140	13788	18600	25638	42570	42570

The Sudan 1987

Figure 2

Boxplot of Total Remuneration by Institute



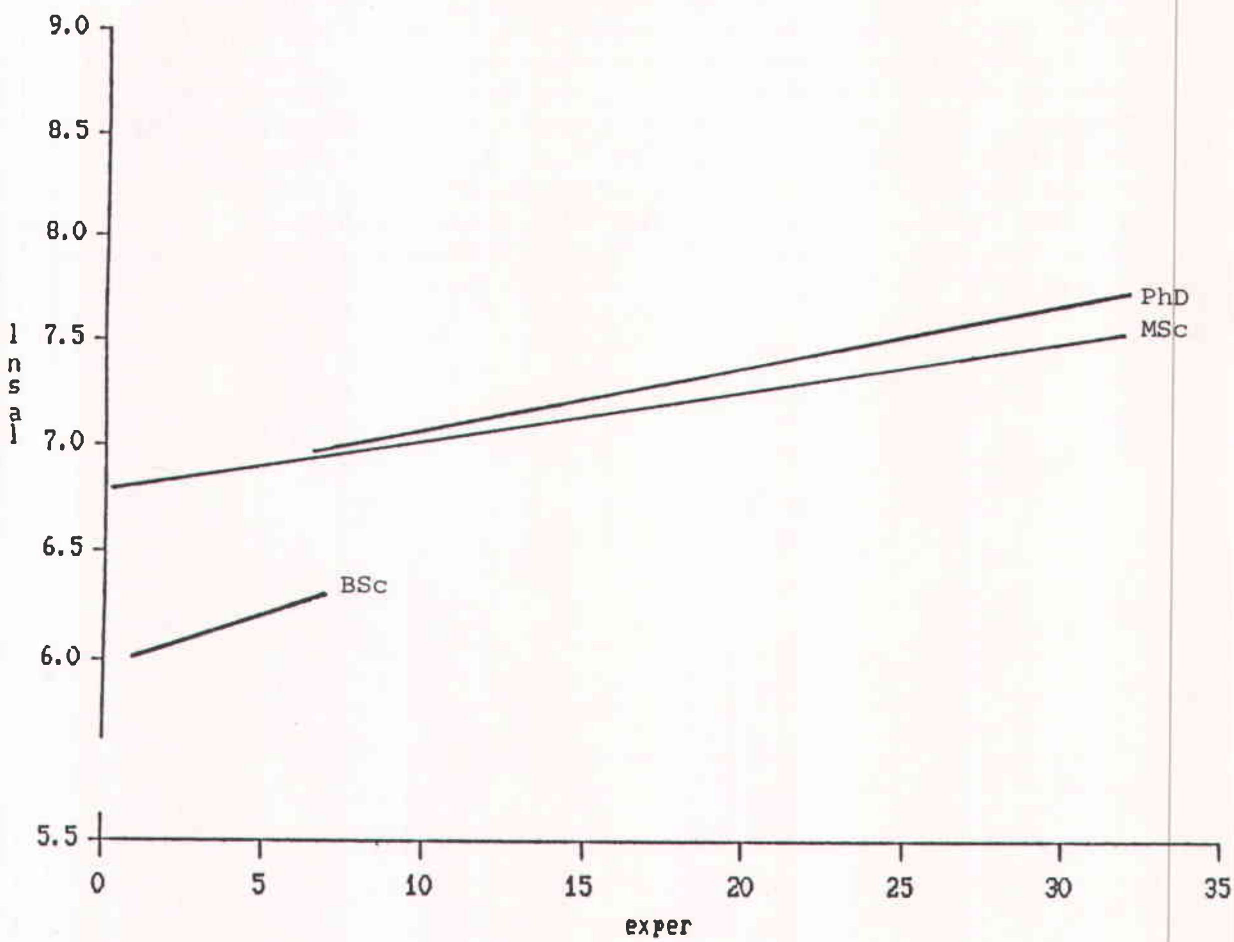
In addition to the boxplots as above, an earnings function of effects on salary of degree earned, age, experience, and professional indicators was calculated. This analysis indicated that there was a positive, statistically significant correlation between experience and education, and the increase in salary in the equations for the ARC, the universities, and the polytechnic institutes. It should be noted, however, that a caution should accompany any judgement based on this information, as data problems existed due to colinearity in independent variables and partial income information.

A final attempt at describing the income was to create an income profile for the ARC as illustrated in Figure 3. This is a two-dimensional form of an income profile with the log of monthly salary on the vertical axis and years of experience on the horizontal axis. The income profile indicates that those holding only bachelor's degrees earn less income, and either terminate their employment with the organization or proceed with higher education. Those researchers holding master's degrees tend to have more longevity with the organization and ultimately earn slightly less than those researchers holding Ph.D.s. As with the previous statement, a cautionary note should accompany this type of analysis. A curvilinear plot would probably more closely represent the situation, and there may be statistical problems due to partial data.

The Sudan 1987

Figure 3

Researchers in ARC



Supplement

To

PART IV

Human Resources

of

The Study

LIST OF TABLES FOR SUDAN ATMS STUDY - HUMAN RESOURCES

SUDAN ATMS Human Resources Inventory

Table 1: List of Personnel by Institution

01/30/88
Page 1

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
101 ARC -- Abu Naamu Research Station				
ADAM	Nasir Eldin Mohamed	44	M	Director of KRS
ALI	Ali El Badawi	34	M	Researcher
ALI	Mirghani Said	41	M	Agronomist
ELIASIR	Mohamed El Hassan Ahmed	35	M	Sesame breeder
ELNADEIF	Suliman Abd Alrahim	34	M	Scientist
ELZEIN	Ibrahim Nour Eldir	40	M	Senior Research Scientist
HASSAN	Alawia Osman Hassan	35	F	Agricultural inspectant
IBRAHIM	Mohamed Ahmed Salih	31	M	Research Scientist
MAHIR	Mutwakil Abdel Mageed	35	M	Plant pathologist
MOHAMMED	El Sadig SUliman	34	M	Scientist/researcher
102 ARC -- Fisheries Research Station (Port Sudan)				
ALI	Sayed Mohamed	39	M	Leader of Sudan IDRC oyster culture project
ELNAIEM	Abdalla Gadain	35	M	Scientist aquaculturre and marine biology
FARAH	Osman Mohamed	41	M	Head, red sea fisheries res. section
RAHAMA	Ismail Haj	37	M	Scientist
103 ARC -- Fisheries Research Station (Shigara)				
ABDEL GABAR	Abdel Gabar Suliman Abdel Gab.	38	M	Senior Research Scient.
AHMED ASMA	Asma Abdel Rahman Ahmed	38	M	Research scientist
BUSHRA ABDELRAHMAN	Sarra	34	F	Research scientist
EL HIGZI	Fatin Abdel Razig Mohamed	30	F	Research assistant
GEORGE	Thomas Tewfik	48	M	Prof.&Head agriculture research section
SAEED	Osman Mohamed	45	M	Director Fisheries Research Centre
104 ARC -- Food Processing Research Center (Shambat)				
ABDALLA	Yahia Magzoub	39	M	Senior scientist
AHMED	Abdelhalim Rahama	39	M	Senior scientist
AHMED	Awatif Muddathin	36	F	Scientist
ARDELMUTI	Omar Moh. Salih	41	M	Senior Scientist
BADI	Sittel Nafar	43	F	Director Food Research Center
BAKEEB	Zubaida Abdel Nabi	34	F	Research scientist
BASHIR	Mohamed El Fatih Hassab El r.	28	M	Researcher in oils and fats
BURENG	Paul Lodu Loro	42	M	Senior Res. scientist
EL MUBARAK	Abdalla El Mubarak Ali	43	M	Research professor Deputy director FRC
ELHASSAN	Mohamed Osman Mohamed	38	M	Research scientist vegetable varit. improvt.
HAMAD	Siddig Hussein	36	M	Research scientist
ISMAIL	Inaam Awad	39	F	Research scientist

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
KHALID	Amna El Subki	39	F	Senior res. scientist Head dept food microbi
KHEIRI	Nour El Huda Abdel Gatel	34	F	Research scientist
MEKKI ELSHAFIE	Ihsan Abbas	37	F	Senior Research scientist
MOHAMED	Sulafeldein Salih	40	M	Research scientist
MUDAWI	Hassan Ali	37	M	Research scientist
MUSA	Sulafa Khalid	42	F	Associate professor
XAHIA	Samira Mohamed Salih	37	F	Scientist at the food research center
YOUSIF	Kahil	40	M	Research scientist
ZAKARIA	Ahmed Badani	40	M	Senior Research Econo- mist

105 ARC -- Forestry Research Station (Soba)

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ABD ELABBAR	Awas El Karim Ibrahim	34	M	Research scientist
ABDALLA RADDAD	Elamin Yousif	31	M	Research Officer
ABU ELGASIM	Zeinab Hashim	35	F	Researcher
ALI	Yahia Hamid	34	M	Research scientist
EL FADL	Mohamed Ahmed	32	M	Research scientist
ELSHEIKH	Alsheikh Abdalla	42	M	Head forest botany sect
HIGAZI	Eltayeb Elhadi Mohamed	40	M	Head Arid Zone ResearchScientist
MAHGOUB	Sayda Mahgoub Mohd Ibrahim	36	F	Researcher forest botany
MAHMOUD	Abdel Latif El Tayeb	41	M	Scientist
NASROUN	Tageldin Hussein	47	M	Dir. forestry res. centre

106 ARC -- Gezira Research Station

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ABBAS	Ihsan	30	M	Assistant scientist
ABDEL GADIR	Abdel Aziz	27	M	Research Assistant scientist
ABDELBAGI	Muktar Ali	28	M	Research scientist assistant
ABDELRAHMAN	Asim ALi	49	M	Professor of entomology
ABDULLA	Hassan Hag	52	M	National coordinator soil research
ADAM	Kamal Mohamed	27	M	Research scientist assistant
AGEEB	Osman Ahmed Ali	48	M	Agronomist national coordinator wheat researc
AHMED	Mirghani	45	M	Associate Prof of vegetable crops
AHMED	Musa Abdalla	45	M	Insect taxonomist
AHMED	Nafisa Elmahi	36	F	Research scientist
ALI	Faisal Mirghani	49	M	Prof. agronomy and plant physiology
ALI	Imad Eldien Ahmed	24	M	Research scientist assistant
ALI	Mohamed Ahmed	30	M	Research assistant scientist
ALI	Naiem Abdalla	41	M	Senior research scientist
ALI	Zakier Ibrahim Ali	28	F	Assistant reserch scientist data collection
ALRAHMAN	Ali	27	M	Assistant research scientist in socio econom.
BABIKER	Abdel Gabbat Eltyeab	38	M	Associate professor
BABIKER	Ibrahim Ahmed	52	M	Dir. gezira agric. res. station
BADERELDEEN	Abdelrhman Mohamed	37	M	Research scientist
BALLA	Ahmed Nasir	48	M	Nat. coordinator entomological research
BASHIR	Hayden Abd Elgaden Mohamed	31	M	Scientist in bioassay studies
BASHIR	Kamal Eldin	25	M	Assistant research scientist
EL AMIN	Eltigani Mohamed	53	M	Director administration and finance
EL SIDDING	Ahamed Mohamed Mustafa	28	M	Research scientist assistant

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
EL ZORGANI	Gaafer Ahmed Babiker	43	M	Professor Research and Administration
ELAHMADI	Abdalla Babiker	46	M	Associate prof. research
ELAHMADI	Abdel Moneim Beshir	51	M	Research professor in plant breeding
ELASHA	El Asha Abdel Hay	29	M	Assistant research scientist
ELBADRI	Gamal Abd alla	28	M	Assistant research scientist
ELBAKHIET	Ibrahim Barakat	40	M	Senior research scientist
ELDIN	Nasr Sharaf	52	M	Research professor entomology
ELHASSAN	Gadalla	36	M	Research scientist soil microbiolog.
ELHUSSEIN	Salah Ahmed	40	M	Senior research scientist
ELOBEID	Ibrahim Osman	38	M	Research scientist
FADLALLA	Ahmed Salih	46	M	Head cotton breeding section
FAGEIRY	Khair Eldin Abd El Galil	33	M	Senior Research Scientist
FARRAG	Hassan Ali	35	M	
GAMEEL	Osman Ibrahim	53	M	Director general agricultural research
GANDOUL	Gandoul Ibrahim	29	M	Assistant research scientist
GENEIF	Ahmed	44	M	National coordinator for horticultural res.
HAMADAIN	Elgeneid Ibrahim	32	M	Assistant researcher
HAMDOUN	Abdalla Mohamed	51	M	Nat. coordinator for botany & plant pathology
HAMID	Gamaleldin Abdel Hay	33	M	Research scientist (pomologist)
HASHIM	Abdel Aziz Abdel Fattah	34	M	Scientist
IBRAHIM	Gaafar	47	M	Associate professor
IBRAHIM	Omer Hasab el Rasoul	28	M	Assistant research scientist
IBRAHIM	Yahia Hassan	28	M	Assistant research scientist
ISHAG	Hassan Mohammed	55	M	National coordinator for groundnut research
LAZIM	Magboul El Hadi	42	M	Agronomist res. investigations
MANSI	Morid Girgis	48	M	Res. professor of statistics
MOHAMED	Abdel Hali A/Wahab	26	M	Research Assistant scientist
MOHAMED	El Tahir Ibrahim	31	M	Research scientist
MOHAMED	Idris Ali Mohamed	30	M	Assistant research scientist
MOHAMED AHMED	Alwahab	26	M	Assistant Research scientist
MOHAMMED KHAIR	Mohamed Ahmed	35	M	Forage research agronomist
MUBARAK	Hassan A/elgadir	34	M	Aquatic weed researcher
MUKHTAR	Nuri Osman	48	M	Head soil science section
MURSAL	Ibraham Eljack	49	M	National coordinator for cotton research
MUSA	Musa Mohamed	51	M	Dep. director general ARC
MUSTAFA	Abdelrasoul Fadlelmula	31	M	Researcher / head forestry res. section
NOUR	Abdellatif M	45	M	Assistant professor
OMER	Mohamed Elhilu	52	M	Res. prof. plant pathology Head of section
SALEEM	Mohamed Badr	55	M	Prof. agronmy & plant physiology
TAMBAL	Hassan Ahamed Ali	29	M	Assistant research scientist
YASSIN	Abdel Mageed	51	M	Chief Pariologist

107 ARC -- Guneid Research Sub-Station

EL TAHIR ZUMRAWI	Awad El Hag	41	M	Senior agronomist
EL TAYEB	Yousif Mohammed	47	M	Assoc. Prof. soil science
HASSAN	Mohammed Elmubarak	37	M	Researcher
SULEIMAN	Waheeb Sakem	34	M	Researcher

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
YASSIN	Mohamed Awadalla	47	M	National coordinator for sugarcan research

108 ARC -- Hudeiba Research Station

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
AHMED	Siir El Khailm Hassan	37	M	Research scientist
MOHAMED	Abdel Gadir Bushara	39	M	Entomologist
MOHAMEDALI	Gaafar Hussein	41	M	Associate res. professor
NOURAI	Abdalla Hussein	38	M	Senior Research Scientist
SHUKH MOHAMED	Abdalla Ibrahim Shuck Mhd	33	M	Research Scientist in breeding field crops
TAHA	Musa Babiker	39	M	Senior research scientist

109 ARC -- Kadugli Research Station

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ABU SABAH	Mohammed Zaim	34	M	Social scientist
AGEEB	Abdel Gadir	31	M	Research scientist
DOW EL MADINA	Ibrahim Mohamed	34	M	Scientist agronomist
EL HAG	Faisal Mohamed Ahmed	30	M	Researcher
EL WAKEEL	Ahmed Sulieman Elwakeel	35	M	Range scientist
HASHIM	Ibrahim Mohamed	41	M	Research scientist
MEKKI	Mahmoud Awad	30	M	Social scientist
SID AHMED	Sid Ahmed Hassan	30	M	60

110 ARC -- Kassala Research Station

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
OSMAN	Mohamed Elnaseeh	42	M	Senior Research Scientist

111 ARC -- Matug Research Station

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
EL AWAD	Sheikh El Din Abdel Gadir	36	M	Scientist

112 ARC -- New Halfa Research Station

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ABDEL RAHMAN	Mohamed Salih Mohamed	45	M	Associate professor and director
AHMED	Mohamed Salih	46	M	Ass. professor of agr. research
DAWOUD	Dawoud Hossein	33	M	Research scientist
GORASHI	Ahmed Mohamed	40	M	Senior agronomist
IBRAHIM	Faisal Mohamed	38	M	Research scientist in Entomology
OSMAN	Aldirdier Gaafar	38	M	Senior Research Scientist

113 ARC -- Obeid Research Station

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ABUELGASIM	El Hag Hassan	42	M	Senior Plant Breeder Direct. Agri.Res. Statio
AHMED EL AWAD	Hassan Osman	38	M	Agronomy research scientist
BALAL	Mohamed El Mukhtar	32	M	Gum research specialist
EL DUKHERI	Ibrahim	29	M	Res. Sen. officer & Agr economist
ELAMIN	Eltighani Mirghani Elamin	33	M	Agric. Economics Res. production & farm Manag
HASSAN	Ahmed El Bashir Mohammed	34	M	Entomology researcher
IBRAHIM	Babiker Abdalla	29	M	Researcher
KURDI	Omer Ibrahim Hassan	37	M	Animal nutrition scientist

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
MANIBO	Gadelkarim Mahmoud	42	M	Research scientist
MUKHTAR	Ashim Khidir	38	M	Range scientist
OSMAN	Abdelrahman Khidir	38	M	Research scientist
OSMAN	Osman Adam	39	M	Horticultirist
114 ARC -- Rahad Research Station				
BABIKER	Elfadil Alrahman Balika	37	M	Research Scientist
DAWELBEIT	Mamoun Ibrahim	38	M	Research scientist
HAMADA	Azhari Abdelazim	51	M	Senior Research Scient.& Dir. of Rahad Statio
KANNAN	Hassan Omer	35	M	Research Scientist
MOHAMED	Mamoun Beshir	40	M	Senior Research Scient.
115 ARC -- Sennar Research Station				
ELAMIN	Mohamed	44	M	Assoc. Prof. Entomology
HARRAN	Mohieldin	42	M	Agricultural Research specialist
KHASHMELMOOS	Ali El Hag	42	M	Senior scientist
OMER	Mohamed Mustafa	38	M	Research scientist on field crops
116 ARC -- Shambat Research Station				
ADAM	Hussein Fadl	35	M	Researcher
EL HASSAN	Hassan Salim	42	M	Associate Professor
MAHMOUD	Mahmoud Ahmed	57	M	National Research Coordinator
MOHAMED	Ali Khalafalla	44	M	Associate Professor (Horticulture)
SHAZALI	Mohamed El Hassan	42	M	Associate Research Professor
SIDDIG	Siddig Ahmed	53	M	Research Prof. in Entomology
117 ARC -- Shendi Research Station				
EL FAHAL	El Awad Mhd Ali	40	M	Senior Research Scientist
MOHAMED	Gaafar El Sarrag	39	M	Senior Research scientist
118 ARC -- West Sudan Research Headquarters (Khartoum)				
DAFALLA	Daffala Ahmed	51	M	Director Western Sudan Agr. Res. project
119 ARC -- Wildlife Research Center (Khartoum)				
ABDELHAMEED	Salwa Mansour	35	M	Researcher
AHMED	Elgaily Osman	37	M	Research scientist
AWADI	Nadir Mohamed	35	M	Research worker
DONGOLA	Gawahir Mohamed	35	F	Researcher
HAKIM	Salah Eldin A'rhman	41	M	Assistant professor
MAHGOUB	El Fatih Eltagi	40	M	Researcher
MOHAMED	Ali Saad	39	M	Research scientist
NIMIR	Mutasim Bashir	42	M	Director Wildlife Res. center

201 APVR -- El Huda Animal Products

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
SULIEMAN	Adam Hassan	41	M	Senior Research officerHead of Sheep res.stat

202 APVR -- Soba Veterinary Research Laboratory

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ABDALLA	Abdu El Dawi	50	M	Ass. Professor, Head dept res. and administ.
ALI	Salah Eldein Abd El Karim	43	M	Res. scientist micology dept.
BABIKER	El Hag Ali	51	M	Research professor of virology
EISA	Amin Mahmoud	57	M	Research Professor
EL WALI	Abdel Azim Ahmed	41	M	Senior res. officer, head dept bact. vaccine
ELAMIN	Mohamed Abdel Gaffar	43	M	Assistant Research prof
IBRAHIM	Abubakr Mohamed	46	M	Senior Researcher
IDRIS	Omer Fadl	51	M	Prof. of biochem. nutrition & toxicology
OSMAN	Osman Mansour	47	M	Head Entomology section
SHOMMEIN	Adam Mohamed	48	M	Research and Diagnosis of animal diseases
TAGELDIN	Mohamed Hassan	44	M	Asso. professor of res. head dept pathology
WAHBI	Abdel Gadir Ahmed Ismail	43	M	Head dept biochemistry, nutrit. & toxicology

203 APVR -- Strukaba Animal Products

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
BADI	Abd Elmoniem Mohamed Ibrahim	43	M	Director N.D.R.C.
EL JACK	El tigani Mohmoud	35	M	Researcher
TALAL	Merghani A/nur	31	M	Head of fodder section

204 APVR -- Um Benien Animal Products Research Station

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
HAKIR	Musaddag Hamid Mohamed	33	M	Fodder Production Exp.

301 NRC -- Economic and Social Research Council

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ALI	Mohamed Adham	37	M	Ass. Dir for administration
GIBRIEL	Mohamed Farah	38	M	Researcher
HAJ ELSAFI	Salah Babiker	34	M	Research fellow
HAMID	Mohamed Nuri	41	M	Research assistant (collection of data)
KABALLO	Sidgi Awas	39	M	Researcher administration
MAHMOUD	Abdelrahim Elrayah	42	M	Res. assistant directorres. on managt of act.

302 NRC -- Agricultural Research Council

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
AHMED	Arif Jamal Mohamed	38	M	Researcher
ELABJAR	Zuheir Elfadil	35	M	Deputy Director for Projects and programs
SAAD	Amir Mustafa	39	F	Senior researcher, Dir. agric. res. council

401 PI -- Abu Haraz

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ABBASHER	Abbasher Awad	32	M	Lecturer
ABDEL HAFIZ	Mohamed	43	M	Senior lecturer

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ABUELGASIM	Eltigani Ahmed	48	M	Deputy Dean, Ass. Prof.
ELFADNI	Saif Eldawla Awad Abdalla	29	M	Teaching assistant
MAGAAD	Azhari Yousif	32	M	Lecturer animal science
OSMAN	Mohed Sared Awad	35	M	Teaching assistant
SALAMA	Abdelmoneim Mohamed	39	M	Lecturer
SALIH	Abdeghani Mohamed	32	M	Lecturer
YOUSIF	Yousif Elnaeem	33	M	Lecturer

402 PI -- Abu Naamu

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ABDELRAHMAN	Mohamed Hassan	43	M	Dean of the college
AWAD	Mohamed Hamad	32	M	Lecturer
AWAD	Talaat Issa	34	M	Lecturer
HASSAN	Hassan Mohamed	38	M	Lecturer and academic secretary
IBRAHIM	Kamla Norain	32	M	Lecturer
OSMAN	Abdelrahman Eltayeb Babikir	41	M	Senior lecturer

403 PI -- Koko

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ALI	Ahmed Omar Mohammed	35	M	Lecturer in management
BARAKAT	Seif Eldawla Mustafa	36	M	Head Dept Anatomy & Physiology
ELFADIL	Hassan Mohamed Elfadil	45	M	Senior lecturer
ELHAGMUSA	Saief Eldawla Omer	37	M	Lecturer
GUMAA	Abuelgasim Yousif	34	M	Senior Lecturer
MOHAMED ELAMIR	Mohamed Kudouda	40	M	Lecturer of livestock management
NARIR	Mohamed Elamin Hamad Ali	42	M	Head of poultry husbandry department
OMAR	Mohammed Warrag	39	M	Lecturer, Head of Dept
OSMAN	Anan Mohd	42	F	Lecturer
OSMAN	Osman Ali	39	M	Senior lecturer

404 PI -- Shambat

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
AHMED	Elsadig Mahdi	42	M	Lecturer
EL SADIG	El Sadig Hassan	44	M	Principal lecturer, associate professor
ELAMIN	Saifeldin	37	M	Lecturer
ELHALI	Abdel Rahman	33	M	Lecturerr
GAAFAR	Mohamed Osman	44	M	Senior lectuere in soil science
HASHIM	Luai Osman	39	M	Senior lecturer
IBRAHIM	Ibrahim Abashar	44	M	Senior Lecturer & head training unit
IBRAHIM	Yassin Mohmed	37	M	Head, Shambat div. of agric. technicians
ISMAIL	Mohamed Ayoub	30	M	Teaching assistant agroc mechanization
MAKKAWI	Abdel Aziz Makkawi Abd.	42	M	Senior lecturer
MOHAMED	Abdelwahab Abdalla	47	M	Principal lecturer
MOHAMED	Said Bashir	38	M	Lectuere and head of agronomy dept.
MUSTAFA	Mustafa Abdelgadir	50	M	Principal lecturer
SALTH	Mohamed Eltigani	33	M	Teaching
TAHA	Awad Khalaf Alla	40	M	Lecturer

405 PI -- Soba

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
DESOUGI	Mohamed Abdo	46	M	Senior lecturer
ELBAHAR	Ibrahim Ali Ahmed	39	M	Lecturer
ELDOMA	Ahmed Mohmed Adam	33	M	Lecturer

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ELMAHDI	El Tigani Satti	49	M	Head forestry techn. division
HAMID	Osman Yousif	39	M	Lecturer
IBNOUF	Mohamed Osman Mohamed	39	M	Teacher
MOHAMED	Tagelsir Elnaiem	31	M	Teacher
MOHAMMED	Abdel Hafeez Ali	38	M	Lecturer in botany

501 UNI -- Department of Agricultural Engineering

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
EL KHAIR	Dia Eloin Omer Mohammed	28	M	Teaching assistant
EL TOM	Omer Mohamed	29	M	Teaching assistant
HOMMEIDA	Mustafa A Mageed	44	M	Lecturer
MUSSALLAM	Elniema	27	M	Teaching assistant
YOUSIF	Elhaj Adam	32	M	Teaching assistant

502 UNI -- Faculty of Agriculture

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
A/MAGID	A Gadir Mohamed	36	M	Lecturer in micobiology
ABBOUDA	Sir El Khatim Khalafalla	40	M	Lecturer
ABDALLA	Mohamed Ragab	36	M	Lecturer
ABDEL BAGI	Azhuri Omer	31	M	Teaching assistant
ABDEL BAGI	Mohamed Ismail	29	M	Teaching assistant
ABDEL RAHMAN	Mohamed El Kheir	37	M	Lecturer MSc supervision
ABU GOUKH	Abu Baker Ati	39	M	Lecturer
ABU SWAR	Awad Osman	35	M	Lectuere
AHMED	Ahmed Hashim	44	M	Lecturer in plant pathology
AHMED	Mohamed Abbakar	32	M	lecturer
AHMED	Omer El khdir	36	M	Lecturer
ALI	Abdalla Moh.	35	M	Lecturer
ALI	El Tayeb El Hag	37	M	Lecturer
BABIKER	Babiker Idris	45	M	Lecturer and head of dept
BAYOUMI	A/Aziz Mohamed Saced	55	M	Associate professor
DAMOUS	Hassan	36	M	Lecturer
DIRAR	Hamid Ahmed	47	M	Lecturer
EL ABDIEN	Abdien Moh. Z.	41	M	Lecturer
EL AMIN	Salah El Tom	32	M	Teaching assistant
EL ATTA	Hashim Ali	31	M	Lecturer
EL AWAD	Salman Hassan	41	M	Lecturer
EL DIN	El Tag Seif	43	M	Lectuere
EL HASSAN	Siddig Mohamed	36	M	Lecturer
EL MULA	Mahmoud Fadl	34	M	Lecturer
EL RASHEED	Mohamed Ahmed	46	M	Head Dept Forestry
EL SIDDIG	El Nour Abdalla	41	M	Lecturer forest management
EL TAHIR	Faroug Hassan	39	M	Lecturer
EL TILIB	A/Moheim Mohamed Ahmed	35	M	Teaching and research
EL TINAY	AbdAlla Hamed	45	M	Professor food chemistry and technology
ELDIN	Anour Gamal	27	M	Teaching assistant
GODA	Salah Eldin	44	M	Lecturrer
HASSAN	Kamil Ibrahim	44	M	Lecturer
HUMEIDA	Ahmed Humeida Ahmed Ali	42	M	Lectuere
IBRAHIM	Ahmed El Bashir	39	M	Lecturer, Head of dept agronomy
ISHAG	Khogali El Nour Ahmed	40	M	Lecturer
KHATTAB	A/El gadir Hassan	55	M	Professor of biochem. & nutrition
KHRISTOVA	Palmina	46	F	Assoc. professor

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
MAHDI	Ahmed Ai Ahmed	40	M	Lecturer
MAHDI	El Fatih Moh.	34	M	Lecturer
MAHGOUB	Salah Ali	37	M	Lecturer
MAHGOUB	Salah El Din Osman	38	M	Lectuere
MIRGHANI	Abdella	33	M	Lecturer
MOHAMED	Babiker El Wasila	35	M	Lecturer
MOHAMED	Mahgoub El Harith	50	M	Lecturer
MOHAMED	Sayed El Bashir	49	M	Professor
MOHAMED AHMED	Idris Alrahman	36	M	Lecturer
MUSA	Tag Eldin El Sheikh	38	M	Lecturer
NAFIE	Nafie Ali	39	M	Lecturer Genetics and Plant Breeding
NOUR	Abdel Azim Ahmed Moh	41	M	Lecturer
NOUR	El Imam El Khidir Moh.	53	M	Professor of Entomology
SALAH EL DIN	Abdalla Ahmed	31	M	Lecturer
SEIF EL NASY	Yousif El Tigani	38	M	Lecturer/researcher
SHAFU	Hayder Abdel	40	M	Lecturer
SHARAWI	Huda Abdel Wahab	29	F	Teaching assistant
SIDDIG	Abdalla Abdel Rahman	37	M	Teaching and research in agr. eng.
SIDDIG	Mohamed A/Haleem	48	M	Lecturer

503 UNI -- Faculty of Veterinary Science

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ABBAS	Babiker	36	M	Lecturer
ABDALLA	Hamid Suliman	43	M	Lecturer
ABDALLA	Mohamed Ahmed	41	M	Associate Professor
ABDEL MAGID	Eltuhami Mohamed	41	M	Associate Professor & Head of Dept.
ALI	Abdelhay Mohamed	30	M	Teaching assistant
ALI	Babreluin Hamid	36	M	Lecturer
BAGADI	Hammad Omer	49	M	Professor research and training
DAFALLA	Elamin	39	M	Lecturer at Fac Vet. Sciences
EL AMIN	El Gailani Ali	36	M	Lecturer
EL HASSAN	Elawad	28	M	Teaching assistant
EL SANOUSI	Sulieman Mohamed	45	M	Head Dept Microbiology
ELFAHIR	Emad Elamin Elthir	28	M	Teaching assistant
FAWI	Mohamed Tewfik	54	M	Prof. of veterinary pathology
HAJER	Ibrahim Elamin	46	M	Lecturer
HAMZA	Ahmed Elnasri	45	M	Lecturer
HASSAN	Tigani	50	F	Professor
HASSAN	Yahia Mohamed	58	M	Professor
HOMEIDA	Abdel Gadir	35	M	Lecturer
IBRAHIM	Abdelaziz El Tayeb	55	M	Professor preventive medicine & vet. pub.heal
ISMAIL	IzzEldin Babikir Ismail	28	M	Teaching assistant
MAGZOUB	Mohmed Elkan	50	M	Head Department of Parasitology
MAHMOUD	Osama Mohamed	39	M	Associate Professor
MIRGANI	Tag El Din	45	M	Assistant Prof., Head of Dept.
MOHAMED	Fathi Hag Ali	39	M	Lecturer
MOHAMED	Galal Eldin Elazhari	38	M	Lecturer
MUSA	Babiker Elhag Musa	44	M	Dean Faculty of vet science
MUSA	Nabila Musa Elbagir	30	F	Teaching assistant
NIMIR	Abdelhafeez Hassan	38	M	Lecturer in vet. microbiology
OSMAN	Dafa Alla Ibrahim	40	M	Lecturer in Anatomy Dept.
SALMAN	Awatif Fath Elrahman	26	F	Teaching assistant

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
TAHA	Ali Abdalla Mohd	38	M	Lecturer
TARTOUR	Ghaboush	50	M	Head Dept of VeterinaryPathology
TINGARI	Muddathir Darberi	48	M	Professor
YASSIN	Tawfig El Tigani Mohamed	34	M	Senior Lecturer

504 UNI -- Institute of Animal Production

ABDALLA	Mohamed Osmon Alalla	27	M	Teaching assistant (practicals)
AWADEL KARIEM	Abdel Moncim Mukhdar	41	M	Lecturer
BABIKER	Salia	40	M	Lecturer
BAYOUNI	Mohamed Said	66	M	Professor Animal Production
EL TAYEB	Ali Elsheikh	36	M	Lecturer
ELZUBEIR	Elfadil	33	M	Lecturer
MAGLAD	Mahmoud	42	M	Assoc. professor
MOHAMMED	Tag Elsir Ahmed	40	M	Lecturer
MUKHTAR	Amer Mohamed Salih	53	M	Prof. of animal product
TIBIN	Ibrahim Musa	37	M	Lecturer head of dept
YOUSIF	Ibrahim	31	M	Teaching assistant

505 UNI -- University of Gezira

ABU SALIM	MIddathir Ali Ahmed	52	M	Associate Professor
AHMED	Mahmoud Hassan	40	M	Associate Professor
ALI	Mohamed Ahmed	41	M	Associate Professor
ATIA	Atta Elmanan Mustafa	27	M	Teaching assistant
BABIKER	Hashim Mahmoud	37	M	Lecturer
BASHIR	Nabil Hamid Hassan	38	M	Associate Professor
EL HAG	Hassan	37	M	Assistant Professor
ELJACK	Ali	35	M	Lecturer
ELTIRAIFI	Mohamed	45	M	Lecturer animal production
FADL	Osman Ahmed Ali	51	M	Dean, Faculty of Agric.Sciences
FREIGOUN	Sami Osman	42	M	Asso. Prof. Pathology, Head Crop Protect. Dep
GADALLA	BadEldin	36	M	Lecturer
HUSSEN	Mohamed Osman	38	M	Assistant professor
IZZELDIN	Hassan Abdalla	41	M	Associate prof. botany & horticulture
MOHAMED	Habib Alla Abdelhafiz	33	M	Lecturer
MOHAMED	Yousif Fadlalla	33	M	Lecturer
MUSHARAF	Nureldin Ahmed	44	M	Associate Professor, Faculty registrar
MUSTAFA	Mohamed Idris	36	M	Lecturer
RAHAMA	Omar Adam	33	M	Lecturer
SATTI	Satti Mohamed Elzein	40	M	Associate Professor of Horticulture
SIDAHMED	Osman A	43	M	Associate Professor
SIRAG	Yahia	46	M	Associate Professor of Agronomy
ZEINELDIN	Faisal Ibrahim	27	M	Teaching assistant

APRA Human Resources Inventory
List of Personnel

(Prepared and provided by APRA Management
at the Seminar on August 2-3, 1988)

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
H.Q. Animal Production Research Administration (APRA)				
EL SHAFIE	Sid Ahmed	55	M	Ass. Professor; Director of APRA
HASSAN	Hassan Mohamed	48	M	Senior Research Scientist, Assistant Director of APRA
ALI	Hamza Osman	45	M	Research Scientist ; Head of Stations Affairs Section
ERAIBI	Abdelmagid Bashir	40	M	Reports & Follow-up Secretariate
EL WASILA	Badreldin	31	M	Livestock Officer
AL HADI	Hatim Ali	38	M	Livestock Officer
Kuku-Poultry Research Centre (KPRC)				
YASSIN	Osama ElSheikh	52	M	Senior Research Scientist; Head of Department of Poultry Research
SALIH	Farouk Ibrahim M.	42	M	Research Scientist
ABDELWAHAB	Isameldin Abdelwahab M.	40	M	Assistant Researcher
WAGEI ALLA	Husseina Ali	37	F	Assistant Researcher
TAHA	Safeia ElZubeir	35	F	Poultry Management Officer
Kuku-Central Animal Nutrition Research Laboratory (CANRL)				
SULIEMAN	Yousif Rizgalla	51	M	Senior Research Scientist; Head of Department of Nutrition
ABDULGADIR	Nadia	41	F	Livestock officer - Nutrition Specialist
FADLALLA	Ahmed Mohamed	37	M	Research Scientist
OMER	Shadia Abdulatti	36	F	Research Scientist
ALLA-GABU	Hussna Ibrahim	32	F	Livestock Officer - Milk Specialist
MABROUK	Afaf Abdulrahim	32	F	Assistant Researcher
Kuku-Meat & Fattening Section (KMFS)				
EL KHEDIR	Omer Abdelrahim	44	M	Senior Research Scientist; Head of Department of Meat & Dairy Research
KHALAFALLA	Abbas Mohamed	49	M	Senior Research Sientist
MURGOS	Francis Ibrahim	35	M	Assistant Researcher
EL KHEDIR	Aetidal Ahmed	33	F	Livestock Officer

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION

Umm Benin - Animal Production Research Station (URS)

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ISAWI	Mohamed Ahmed	49	M	Senior Research Scientist; Head of Station
MOHAMADEIN	Ali Dinar	42	M	Senior Research Scientist
OSMAN	Adam Gumaa	40	M	Senior Research Scientist
ABDULRAHMAN	Moheldin Hassan	36	M	Research Scientist
ABDULWAHAB	Kamal	33	M	Livestock Officer - Nutrition Specialist
ELSAYED	Shaaban	33	M	Livestock Officer

El Shukaba - National Dairy Research & Production Centre (NDRC)

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
BADI	Abdulmoneim Mohd Ibrahim	44	M	Research Scientist; Head of Station
ABDALLA	El Tayeb Ali	42	M	Assistant Researcher
SHEGEDI	Mohamed Taha M.	41	M	Assistant Researcher
EL JACK	El Tigani Mahmond	37	M	Research Scientist
ABDULRAZIG	Mahasin	32	F	Livestock Officer
ABDELNOUR	Tilal Mirgani	32	M	Livestock Officer
GASM ELSEED	Mamoun Mohamed	31	M	Livestock Officer
ABDULAZIM	Neimat	37	F	Livestock Officer - Nutrition Specialist

Ghazala Gawazat: Animal Production Research Station (GRS)

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
ABDULAZIZ	Farouk Mohamed	37	M	Acting Head of Station; Livestock Officer

El Huda - Sheep Research Station (HRS)

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
SULIEMAN	Adam Hassan	42	M	Senior Research Scientist; Head of Station; Head Dept. Breeding
AHMED	Hassan El Hag	45	M	Livestock Officer - Nutrition Specialist
ABDALLA	Sidig Adam	39	M	Livestock Officer - Nutrition Specialist
MANSOUR	Muawia El Hassan	36	M	Livestock Officer - Nutrition Specialist

Atbara - Dairy Research Station (ARS)

SURNAME	GIVEN NAME	AGE	SEX	JOB DESCRIPTION
TAGELDIN	Hassan Abdelrahim	38	M	Livestock Assistant Researcher
NASR	Ali Mohamed	38	M	Assistant Researcher
KHALID	Abdalla El Toum	32	M	Livestock Officer
AHMED	Suad Mahmound	32	F	Livestock Officer

SUDAN ATMS Human Resources Inventory

Table 1b: Demographic Information by Institut (6 age groups)

02/01/88
Page 1

INSTITUTION CODE	NUMBER OF RESEARCHERS	AVERAGE AGE	NUMBER MALE	NUMBER FEMALE	NUMBER OF RESEARCHERS IN EACH AGE CATEGORY Under 25	25-34	35-44	45-54	55-64	65 and Over
100 ARC -- Agricultural Research Corporation										
101	10	37	9	1	0	1	8	1	0	0
102	4	39	4	0	0	0	4	0	0	0
103	6	39	4	2	0	1	3	2	0	0
104	21	39	12	9	0	1	20	0	0	0
105	10	38	8	2	0	2	7	1	0	0
106	65	39	63	2	0	25	14	24	2	0
107	5	42	5	0	0	0	3	2	0	0
108	6	38	6	0	0	1	5	0	0	0
109	8	34	8	0	0	4	4	0	0	0
110	1	43	1	0	0	0	1	0	0	0
111	1	37	1	0	0	0	1	0	0	0
112	6	41	6	0	0	1	3	2	0	0
113	12	36	12	0	0	4	8	0	0	0
114	5	41	5	0	0	0	4	1	0	0
115	4	42	4	0	0	0	3	1	0	0
116	6	46	6	0	0	0	3	2	1	0
117	2	40	2	0	0	0	2	0	0	0
118	1	52	1	0	0	0	0	1	0	0
119	8	39	7	1	0	0	8	0	0	0
	181	39	164	17	0	40	101	37	3	0
200 APVR - Animal Production and Vet Research										
201	1	42	1	0	0	0	1	0	0	0
202	12	48	12	0	0	0	4	7	1	0
203	3	37	3	0	0	1	2	0	0	0
204	1	34	1	0	0	1	0	0	0	0
	17	44	17	0	0	2	7	7	1	0
300 NRC -- National Research Council										
301	6	39	6	0	0	0	6	0	0	0
302	3	38	2	1	0	0	3	0	0	0
	9	39	8	1	0	0	9	0	0	0
400 PI -- Polytechnic Institute										
401	9	36	9	0	0	5	3	1	0	0
402	6	37	6	0	0	2	4	0	0	0
403	10	39	9	1	0	0	9	1	0	0
404	15	41	15	0	0	3	7	5	0	0
405	8	40	8	0	0	2	4	2	0	0
	48	39	47	1	0	12	27	9	0	0

INSTITUTION CODE	NUMBER OF RESEARCHERS	AVERAGE AGE	NUMBER MALE	NUMBER FEMALE	------ NUMBER OF RESEARCHERS IN EACH AGE CATEGORY ------- Under 25	25-34	35-44	45-54	55-64	65 and Over
500 UNI -- Universities										
501	5	33	5	0	0	4	0	1	0	0
502	56	40	54	2	0	9	33	12	2	0
503	34	41	31	3	0	6	15	10	3	0
504	11	41	11	0	0	3	6	1	0	1
505	23	39	23	0	0	5	13	5	0	0
	129	40	124	5	0	27	67	29	5	1

SUDAN ATMS Human Resources Inventory

Table 2: Educational Background of Agricultural Researchers by Institution

01/30/88
Page 1

	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
101 ARC -- Abu Naamu Research Station									
1000 AGRICULTURE IN GENERAL									
	1	0	0	1981	2	3	3	0	
1410 Agronomy									
	1	1	0	1978	2	3	0	0	
	1	1	1	1983	0	3	1	0	
	1	1	0	1987	0	2	0	0	
1440 Plant Genetics and Breeding									
	1	0	1	1980	1	3	0	0	
	1	1	0	1982	2	2	0	0	
1510 Plant Pathology									
	1	0	1	1985	0	2	0	0	
1530 Herbicides and Pesticides									
	1	0	1	1983	0	3	0	0	
1600 ENTYMOLOGY									
	1	1	0	1986	1	2	0	0	
2120 Soil Science									
	1	1	0	1985	0	3	0	0	
102 ARC -- Fisheries Research Station (Port Sudan)									
2130 Marine Studies									
	1	1	0	1982	1	3	0	0	
	1	1	1	1982	0	3	0	0	
	1	1	1	1983	3	3	0	1	Russian (1)
	1	1	0	1984	3	3	0	0	
103 ARC -- Fisheries Research Station (Shigara)									
1840 Zoology									
	1	1	0	1979	5	3	0	2	
	1	0	0	1981	1	3	0	1	
1900 FISHERIES									
	1	1	0	1973	4	3	1	1	
	1	0	1	1981	1	3	0	0	
1910 Limnology									
	1	1	0	1976	1	3	0	1	
	1	1	0	1980	0	2	0	0	
104 ARC -- Food Processing Research Center (Shambat)									
1000 AGRICULTURE IN GENERAL									
	1	1	0	1980	0	3	0	0	
1310 Agricultural Economics									

	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
	1	1	0	1979	0	3	0	0	
1420 Horticulture									
	1	1	1	1980	1	3	0	0	
	1	1	1	1984	0	3	0	0	
1450 Crop Physiology									
	1	1	0	1978	0	3	0	0	Slavic (3)
	1	1	0	1980	0	3	0	0	
2200 FOOD SCIENCE									
	1	1	1	1975	0	3	0	0	
	1	1	1	1979	0	3	0	0	
	1	1	1	1980	0	3	0	0	
	1	1	0	1980	2	2	0	0	
	1	1	0	1980	2	3	0	0	
	1	1	1	1981	2	3	0	0	
	1	1	1	1981	0	3	0	0	
	1	1	1	1982	0	3	0	1	
	1	1	0	1984	0	2	0	0	
	1	1	0	1986	0	2	1	0	
	1	1	1	1986	1	3	0	3	
	1	1	1	1986	0	3	1	0	
	1	1	1	1986	1	3	0	3	
	1	1	1	1986	1	3	0	0	
	1	1	1	1987	0	3	0	0	

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105 ARC -- Forestry Research Station (Soba)

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	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1430 Botany									
	1	1	0	1982	0	2	0	0	
	1	1	0	1985	0	2	0	0	
1450 Crop Physiology									
	1	1	0	1986	0	3	1	0	
1700 FORESTRY									
	1	1	1	1978	1	3	1	0	
	1	1	0	1981	0	2	0	0	
	1	1	0	1984	0	2	0	0	Bulgarian (2) Russian (1)
	1	1	0	1987	1	3	2	0	
1820 Animal Nutrition									
	1	1	0	1981	0	3	1	0	
2100 NATURAL RESOURCES AND ENVIRONMENT									
	1	1	0	1981	0	3	0	0	
	1	1	0	1986	4	2	1	0	

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106 ARC -- Gezira Research Station

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	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1000 AGRICULTURE IN GENERAL									
	1	1	1	983	0	0	0	0	
	1	0	0	1984	0	3	1	0	
1310 Agricultural Economics									
	1	1	0	1983	1	3	0	0	
	1	0	0	1985	0	3	1	0	
	1	0	0	1985	0	2	1	0	
	1	0	0	1985	1	3	0	0	
1311 Mathematics and Statistics									

BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
1	1	0	1965	6	3	1	0	
1	1	1	1985	0	3	0	0	
1400 PLANT SCIENCE AND PRODUCTION								
1	0	1	1970	1	2	0	2	
1	1	1	1975	0	3	0	0	
1	0	1	1976	0	3	0	0	
1	0	1	1977	0	3	0	1	
1	0	0	1982	0	2	0	0	
1410 Agronomy								
1	0	1	1968	2	3	0	0	
1	0	0	1982	1	3	0	0	
1	0	0	1983	1	2	0	0	
1	0	0	1983	1	2	0	0	
1	0	0	1984	1	2	0	0	
1	1	1	1984	0	3	0	0	
1	0	0	1984	2	2	0	0	
1	0	0	1985	0	2	1	0	
1420 Horticulture								
1	0	0	1984	1	2	0	0	
1421 Pomology								
1	1	1	1985	1	3	0	0	
1	1	1	1985	1	3	0	0	
1430 Botany								
1	1	0	1976	0	3	0	0	
1440 Plant Genetics and Breeding								
1	1	1	1974	3	3	0	0	
1	1	1	1974	0	3	0	0	
1	1	1	1975	0	3	0	0	
1	1	1	1976	3	3	0	0	
1	1	1	1977	4	3	0	0	
1	1	1	1984	1	3	0	0	
1	1	1	1984	1	3	0	0	
1	1	0	1985	1	2	0	0	
1450 Crop Physiology								
1	1	1	1970	0	3	1	0	
1	1	1	1977	4	3	0	0	
1	1	1	1978	0	3	0	0	
1500 PLANT PROTECTION								
1	0	0	1984	0	2	1	0	
1	0	0	1984	0	3	0	0	
1	1	0	1987	0	3	0	0	
1510 Plant Pathology								
1	1	1	1965	2	3	0	0	
1	0	1	1966	1	3	0	0	
1	1	1	1978	4	3	0	0	
1	0	1	1982	1	3	0	0	
1520 Weed Science								
1	1	0	1967	0	3	0	0	
1	1	0	1984	0	3	0	0	
1530 Herbicides and Pesticides								
1	0	1	1976	0	3	0	0	
1	0	0	1980	1	2	0	0	
1	0	0	1984	0	2	0	0	

BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
1600 ENTYMOLOGY								
1	0	1	1600	1	3	0	0	
1	0	1	1961	2	3	1	3	
1	0	1	1963	2	3	0	0	
1	0	1	1966	0	3	0	0	
1	1	1	1970	2	3	0	0	
1	1	1	1982	0	3	1	1	
1700 FORESTRY								
1	1	0	1981	1	1	0	0	
1840 Zoology								
1	0	1	1966	0	3	0	0	
2000 AGRICULTURAL MACHINERY AND								
1	0	0	1984	0	3	0	0	
1	0	0	1985	0	3	0	0	
1	0	0	1986	0	3	0	0	
2120 Soil Science								
1	0	1	1963	1	2	0	0	
1	0	1	1966	2	3	0	0	
1	1	1	1974	1	3	0	0	
1	1	1	1985	0	3	0	0	
1	0	0	1985	0	2	1	0	
2125 Soil Biochemistry								
1	1	1	1981	4	3	0	0	

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107 ARC -- Guneid Research Sub-Station

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1410 Agronomy								
1	1	1	1976	0	3	0	0	
1510 Plant Pathology								
1	0	1	1883	0	3	0	0	
1520 Weed Science								
1	1	1	1982	2	3	0	0	
2000 AGRICULTURAL MACHINERY AND								
1	1	0	1983	0	3	0	0	
2120 Soil Science								
1	0	1	1972	1	3	0	0	

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108 ARC -- Hudeiba Research Station

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1420 Horticulture								
1	1	1	1980	0	3	0	0	
1440 Plant Genetics and Breeding								
1	0	1	1977	1	3	0	0	
1	1	0	1982	1	2	0	0	
1450 Crop Physiology								
1	1	1	1979	0	3	0	0	
1600 ENTYMOLOGY								
1	1	1	1981	0	3	0	0	
2120 Soil Science								
1	1	1	1984	0	3	0	0	

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109 ARC -- Kadugli Research Station

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BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
1310 Agricultural Economics								
1	1	0	1985	1	3	0	0	
1320 Rural Sociology								
1	1	0	1982	2	3	0	0	
1	1	0	1986	1	3	0	0	
1410 Agronomy								
1	1	0	1985	0	3	0	0	
1810 Animal Husbandry								
1	1	0	1986	0	3	0	0	
1	1	0	1986	0	3	0	0	
2140 Range Science								
1	1	1	1980	1	3	0	0	
1	0	1	1984	0	3	0	0	
110 ARC -- Kassala Research Station								
1411 Vegetable Crops								
1	1	1	1977	2	3	0	0	
111 ARC -- Matug Research Station								
2000 AGRICULTURAL MACHINERY AND								
1	1	0	1982	0	3	0	0	
112 ARC -- New Halfa Research Station								
1410 Agronomy								
1	1	1	1977	3	3	0	1	
1421 Pomology								
1	1	0	1982	0	2	0	0	
1440 Plant Genetics and Breeding								
1	1	1	1975	3	3	0	0	
1510 Plant Pathology								
1	1	1	1975	2	3	0	0	
1531 -0-								
1	0	1	1981	0	3	0	0	
1600 ENTYMOLOGY								
1	1	1	1984	2	0	0	0	
113 ARC -- Obeid Research Station								
1300 AGRICULTURAL ECONOMICS, DEVELOPMENT								
1	1	0	1987	0	3	0	0	
1310 Agricultural Economics								
1	1	1	1987	0	3	1	0	
1410 Agronomy								
1	1	0	1982	3	2	0	0	Bulgarian (2) Russian (1)
1411 Vegetable Crops								
1	1	1	1982	0	3	0	0	
1440 Plant Genetics and Breeding								
1	1	1	1982	6	3	0	0	
1450 Crop Physiology								
1	1	1	1984	0	1	0	3	

BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
1600 ENTYMOLOGY								
1	0	1	1984	0	3	1	0	
1700 FORESTRY								
1	1	0	1983	3	3	1	0	
1820 Animal Nutrition								
1	1	1	1984	0	3	0	0	
2120 Soil Science								
1	1	0	1985	0	3	1	0	
1	1	1	1986	2	3	0	3	
2140 Range Science								
1	1	0	1982	2	3	0	0	

114 ARC -- Rahad Research Station

1410 Agronomy								
1	1	1	1984	0	3	2	0	
1411 Vegetable Crops								
1	1	1	1978	0	3	0	0	
1500 PLANT PROTECTION								
1	1	0	1977	0	2	0	0	
1600 ENTYMOLOGY								
1	1	1	1984	0	3	0	0	
2000 AGRICULTURAL MACHINERY AND								
1	1	1	1983	0	3	0	0	

115 ARC -- Sennar Research Station

1420 Horticulture								
1	1	1	1979	0	0	3	1	
1440 Plant Genetics and Breeding								
1	1	0	1974	0	3	0	0	
1450 Crop Physiology								
1	1	1	1984	0	3	0	0	Russian (3)
1600 ENTYMOLOGY								
1	0	1	1975	0	3	0	0	

116 ARC -- Shambat Research Station

1420 Horticulture								
1	1	1	1976	2	3	0	0	
1440 Plant Genetics and Breeding								
1	1	0	1960	0	3	0	0	
1450 Crop Physiology								
1	1	1	1977	1	3	0	0	
1520 Weed Science								
1	0	1	1985	0	2	0	0	
1600 ENTYMOLOGY								
1	0	1	1966	0	3	0	2	
1	1	1	1982	0	3	0	0	

117 ARC -- Shendi Research Station

1410 Agronomy

Field	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
	1	0	1	1978	1	3	0	0	
1420 Horticulture									
	1	1	1	1977	0	3	0	0	

118 ARC -- West Sudan Research Headquarters

Field	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1450 Crop Physiology									
	1	1	1	1974	3	3	0	0	

119 ARC -- Wildlife Research Center (Khartoum)

Field	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1430 Botany									
	1	1	0	1985	0	3	0	0	
1832 Veterinary Pathology									
	1	1	0	1977	0	3	0	0	
2100 NATURAL RESOURCES AND ENVIRONMENT									
	1	1	0	1975	2	3	0	1	
	1	1	1	1983	0	3	0	0	
2140 Range Science									
	1	1	1	1983	1	3	0	0	
	1	1	1	1984	0	3	1	0	
	1	1	1	1985	0	3	0	0	
	1	1	1	1985	0	3	0	0	

201 APVR -- El Huda Animal Products

Field	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1810 Animal Husbandry									
	1	1	1	1982	2	3	1	0	

202 APVR -- Soba Veterinary Research Laboratory

Field	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1820 Animal Nutrition									
	1	1	1	1966	4	3	1	0	
1830 Veterinary Science									
	1	0	1	1968	4	3	0	2	
	1	0	1	1978	3	3	0	0	
	1	0	1	1978	1	2	0	0	
	1	0	1	1981	0	2	0	0	Russian (2)
	1	1	1	1982	0	3	0	0	
	1	1	1	1983	6	3	0	0	
1831 Veterinary Epidemiology									
	1	0	1	1980	2	3	0	0	Russian (2)
1832 Veterinary Pathology									
	1	1	0	1961	2	3	1	0	
	1	0	1	1971	3	3	0	0	Russian (2)
	1	0	1	1974	4	3	1	0	
	1	0	1	1974	1	3	0	0	Russian (3)

203 APVR -- Strukaba Animal Products

Field	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1000 AGRICULTURE IN GENERAL									
	1	0	1	1981	0	3	0	0	
1800 ANIMAL SCIENCE AND PRODUCTION									

BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
1	1	0	1985	0	3	0	0	
1810 Animal Husbandry								
1	0	0	1980	0	2	0	0	
204 APVR -- Um Benien Animal Products Research								
1820 Animal Nutrition								
1	1	0	1983	0	3	0	0	
301 NRC -- Economic and Social Research Council								
1010 Marketing								
1	1	0	1979	2	3	0	0	
1020 Business Management								
1	1	1	1983	4	3	0	0	
1300 AGRICULTURAL ECONOMICS, DEVELOPMENT								
1	1	1	1984	0	3	0	0	
1	1	0	1984	0	3	0	0	
1	1	0	1984	0	2	0	0	
1	1	0	1987	1	3	0	0	
302 NRC -- Agricultural Research Council								
1500 PLANT PROTECTION								
1	1	1	1980	4	3	3	0	Ethiopian (2)
1	1	1	1985	0	3	0	0	
1832 Veterinary Pathology								
1	0	1	1979	3	3	0	0	
401 PI -- Abu Haraz								
1000 AGRICULTURE IN GENERAL								
1	0	0	1977	1	3	0	2	
1120 Extension								
1	1	0	1981	0	3	1	0	
1411 Vegetable Crops								
1	1	0	1982	0	3	0	0	
1500 PLANT PROTECTION								
1	0	0	1986	0	3	0	0	
1510 Plant Pathology								
1	1	0	1976	1	3	0	0	
1	1	0	1983	0	3	1	0	
1800 ANIMAL SCIENCE AND PRODUCTION								
1	1	0	1986	0	3	0	0	
2000 AGRICULTURAL MACHINERY AND								
1	1	0	1983	0	3	0	0	
2120 Soil Science								
1	1	0	1983	0	3	0	0	
402 PI -- Abu Naamu								
1410 Agronomy								
1	1	0	1976	1	3	0	0	

BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
1420 Horticulture								
1	1	1	1984	0	3	0	0	
1	1	0	1985	0	3	0	0	
1600 ENTYMOLOGY								
1	1	0	1983	1	2	0	0	
2120 Soil Science								
1	1	0	1980	1	3	0	0	
2140 Range Science								
1	1	0	1985	1	3	0	0	

403 PI -- Koko

BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1120 Extension								
1	1	0	1984	2	2	0	0	
1310 Agricultural Economics								
1	1	0	1979	0	2	0	1	
1810 Animal Husbandry								
1	1	0	1985	1	2	3	0	
1811 Dairy Science								
1	1	1	1978	2	2	0	0	
1	0	1	1981	2	2	0	0	
1812 Meat Science								
1	1	0	1981	2	2	0	0	
1813 Poultry Science								
1	1	0	1976	5	3	0	0	
1	1	0	1980	1	2	0	0	
1830 Veterinary Science								
1	1	0	1981	3	2	0	0	
1832 Veterinary Pathology								
1	1	1	1986	0	3	0	0	

404 PI -- Shambat

BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1312 Development economics and policies								
1	1	0	1982	0	2	0	0	
1400 PLANT SCIENCE AND PRODUCTION								
1	1	1	1987	1	3	0	0	
1410 Agronomy								
1	1	0	1978	0	3	0	0	
1	1	1	1984	0	3	0	0	
1420 Horticulture								
1	1	0	1972	0	2	0	0	
1500 PLANT PROTECTION								
1	1	0	1968	2	3	0	0	
1510 Plant Pathology								
1	1	0	1979	2	2	0	0	
1600 ENTYMOLOGY								
1	1	0	1979	4	3	0	0	
1	1	1	-0-	1	3	0	0	
1810 Animal Husbandry								
1	1	0	1986	0	3	0	0	
1	1	1	1987	1	3	0	0	
2000 AGRICULTURAL MACHINERY AND								

BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
1	1	0	1984	2	3	0	0	
1	1	0	1985	0	2	0	0	
1	1	0	1986	0	3	0	0	
2120 Soil Science								
1	1	0	1983	1	3	0	0	

405 PI -- Soba

1700 FORESTRY								
1	0	0	1963	1	3	0	0	
1	0	0	1982	2	2	0	0	
1	1	1	1983	2	3	0	0	Russian (3)
1	1	0	1984	1	2	0	0	
1	0	0	1984	1	3	0	0	
2100 NATURAL RESOURCES AND ENVIRONMENT								
1	1	1	1980	1	3	0	0	
1	1	0	1985	1	3	0	0	
1	1	0	1986	2	2	0	0	

501 UNI -- Department of Agricultural Engineering

1000 AGRICULTURE IN GENERAL								
1	0	0	1984	0	2	0	0	
2000 AGRICULTURAL MACHINERY AND								
1	1	1	1981	0	3	0	0	
1	0	0	1983	0	3	0	0	
1	0	0	1983	0	3	0	0	
1	1	0	1984	3	2	1	0	

502 UNI -- Faculty of Agriculture

1000 AGRICULTURE IN GENERAL								
1	1	1	1983	1	3	0	0	Italian (1)
1020 Business Management								
1	0	1	1974	0	3	1	0	Indonesian (2)
1310 Agricultural Economics								
1	1	1	1980	0	2	0	0	
1	1	1	1982	0	3	0	0	
1	1	1	1986	2	3	0	0	
1311 Mathematics and Statistics								
1	1	1	1975	4	2	0	0	
1410 Agronomy								
1	1	1	1979	0	3	0	0	
1	1	1	1981	1	3	0	0	
1	1	1	1981	1	3	0	2	
1	1	1	1986	0	3	0	0	
1	1	0	1987	0	3	1	0	
1411 Vegetable Crops								
1	1	1	1982	0	3	0	0	
1420 Horticulture								
1	1	1	1982	0	3	0	0	
1	1	0	1984	0	3	0	0	
1	1	1	1986	0	3	0	0	

	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
	1	1	1	1986	4	3	0	0	
1430	Botany								
	1	1	1	1985	1	3	0	0	
1440	Plant Genetics and Breeding								
	1	1	1	1980	5	3	0	0	
	1	1	1	1985	1	3	0	0	
1450	Crop Physiology								
	1	0	1	1980	2	3	0	0	
	1	1	1	1982	0	3	0	0	
1500	PLANT PROTECTION								
	1	1	1	1976	3	3	0	0	
	1	1	1	1984	0	3	0	0	
1510	Plant Pathology								
	1	1	1	1973	1	3	0	0	
	1	1	1	1981	1	3	0	0	
	1	1	1	1981	1	3	0	0	
	1	1	0	1985	1	3	1	0	
1530	Herbicides and Pesticides								
	1	1	0	1987	1	3	0	0	
1600	ENTYMOLOGY								
	1	1	1	1978	4	3	1	1	
	1	1	1	1984	1	3	0	0	
1700	FORESTRY								
	1	1	0	1973	4	3	0	0	
	1	1	1	1974	0	3	2	1	Russian (3) Bulgarian (3)
	1	1	1	1980	1	3	0	0	
	1	0	1	1984	1	3	0	0	
	1	1	1	1985	4	3	1	0	
	1	1	1	1986	0	3	0	3	
	1	1	0	1987	1	2	0	0	
1840	Zoology								
	1	1	1	1963	0	3	0	0	
	1	0	1	1966	3	3	0	0	
2000	AGRICULTURAL MACHINERY AND								
	1	0	1	1973	2	3	0	0	
	1	1	1	1981	1	3	0	0	
	1	1	1	1982	1	3	0	0	
	1	1	1	1984	0	3	0	0	
	1	0	1	1984	1	0	3	0	
	1	1	1	1985	2	2	2	0	
2120	Soil Science								
	1	1	1	1980	2	3	1	0	
	1	1	1	1984	3	3	0	3	
2125	Soil Biochemistry								
	1	1	1	1969	0	3	0	0	
	1	1	1	1982	1	3	0	0	
	1	1	1	1984	2	3	3	3	
2200	FOOD SCIENCE								
	1	1	1	1972	4	3	2	0	
	1	1	1	1979	0	3	0	0	
	1	1	1	1982	0	3	0	0	
2210	Food Biochemistry								
	1	1	1	1963	2	3	0	0	

BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
1	1	1	1977	0	3	0	0	
1	0	1	1984	0	3	0	0	

503 UNI -- Faculty of Veterinary Science

BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1830 Veterinary Science								
1	1	1	1961	1	3	3	2	
1	1	1	1967	2	3	0	0	
1	1	1	1969	0	3	1	0	
1	1	1	1969	2	3	0	0	
1	1	1	1970	2	3	1	0	
1	1	1	1971	1	3	0	1	
1	1	1	1973	2	3	0	0	
1	1	1	1974	3	3	0	0	
1	0	1	1975	0	3	0	0	
1	1	1	1976	0	3	0	0	
1	1	1	1980	0	3	0	1	
1	1	1	1980	2	3	0	0	
1	0	1	1980	0	3	0	0	
1	1	1	1981	2	3	0	0	
1	1	1	1981	1	3	0	0	
1	0	1	1981	2	3	0	2	
1	0	0	1982	0	2	0	0	
1	0	1	1982	0	3	0	0	
1	0	0	1982	0	3	0	0	
1	0	1	1982	1	3	0	0	
1	0	0	1982	0	3	1	0	
1	1	1	1983	1	3	0	0	
1	0	1	1984	0	3	0	0	
1	1	1	1984	2	3	0	0	
1	0	0	1985	0	2	0	0	
1	0	0	1985	0	2	0	0	
1	0	0	1985	0	3	0	0	
1831 Veterinary Epidemiology								
1	1	1	1978	3	3	0	0	
1832 Veterinary Pathology								
1	1	1	1962	1	3	1	0	
1	1	1	1977	2	3	0	0	
1	1	1	1981	0	3	0	0	
1833 Veterinary Histology								
1	0	1	1966	3	3	3	1	
1	1	1	1976	0	3	0	0	
1	1	1	1978	0	3	0	0	

504 UNI -- Institute of Animal Production

BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1810 Animal Husbandry								
1	1	1	1951	3	3	0	0	
1	1	1	1982	0	3	0	0	
1	1	1	1983	2	3	0	0	
1	1	0	1987	1	2	0	0	
1811 Dairy Science								
1	1	1	1979	2	3	0	0	

	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	LANGUAGES (0=NO KNOWLEDGE,3=VERY GOOD) English	French	German	OTHERS:
	1	1	0	1985	1	3	0	0	
1812 Meat Science									
	1	1	1	1973	0	3	0	0	
	1	1	1	1982	0	3	0	0	
1813 Poultry Science									
	1	0	1	1986	0	3	0	0	
1820 Animal Nutrition									
	1	1	1	1966	0	3	0	0	
	1	1	1	1982	1	3	0	0	

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505 UNI -- University of Gezira

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	BS DEGREE	MS DEGREE	PHD DEGREE	GRADUATION YEAR	NUMBER OF SHORT COURSES	English	French	German	OTHERS:
1310 Agricultural Economics									
	1	1	1	1972	2	3	1	0	
1410 Agronomy									
	1	1	1	1982	1	3	0	0	
1420 Horticulture									
	1	1	1	1981	1	3	0	0	
1430 Botany									
	1	1	1	1978	1	2	0	0	
1440 Plant Genetics and Breeding									
	1	0	1	1984	0	2	0	0	
1450 Crop Physiology									
	1	1	1	1975	0	3	0	0	
1500 PLANT PROTECTION									
	1	1	1	1984	0	3	0	0	
	1	1	1	1985	2	3	0	0	
1510 Plant Pathology									
	1	0	1	1974	2	3	0	0	
	1	0	1	1983	2	3	0	0	
1600 ENTYMOLOGY									
	1	1	1	1982	0	3	1	0	
1810 Animal Husbandry									
	1	1	1	1983	0	3	0	0	
1813 Poultry Science									
	1	1	1	1983	0	3	0	0	
1830 Veterinary Science									
	1	1	1	1986	1	3	0	0	
2000 AGRICULTURAL MACHINERY AND									
	1	1	0	1977	2	3	0	0	
	1	1	0	1980	0	3	0	0	
	1	0	0	1984	0	2	0	0	
	1	0	0	1984	0	2	0	0	
	1	1	1	1986	3	3	0	0	
2110 Environmental Physics									
	1	0	1	1984	1	3	0	0	
2120 Soil Science									
	1	1	1	1968	2	3	0	0	(3)
	1	1	1	1983	2	3	1	0	
2140 Range Science									
	1	1	1	1984	1	3	0	1	

SUDAN ATMS Human Resources Inventory

Table 2a: Percent of Researchers Holding BS, MS, and PhD Degrees

01/30/88
Page 1

INSTITUTION CODE & NAME	TOTAL # OF RESEARCHERS	% holding as highest degree: BS DEGREE	MS DEGREE	PhD DEGREE
100 ARC -- Agricultural Research Corporation				
101	10	10	50	40
102	4	0	50	50
103	6	16	66	16
104	21	0	38	61
105	10	0	90	10
106	65	30	12	56
107	5	0	20	80
108	6	0	16	83
109	8	0	75	25
110	1	0	0	100
111	1	0	100	0
112	6	0	16	83
113	12	0	41	58
114	5	0	20	80
115	4	0	25	75
116	6	0	16	83
117	2	0	0	100
118	1	0	0	100
119	8	0	37	62
	181	12	31	56
200 APVR - Animal Production and Vet Research				
201	1	0	0	100
202	12	0	8	91
203	3	33	33	33
204	1	0	100	0
	17	5	17	76
300 NRC -- National Research Council				
301	6	0	66	33
302	3	0	0	100
	9	0	44	55
400 PI -- Polytechnic Institute				
401	9	22	77	0
402	6	0	83	16
403	10	0	70	30
404	15	0	73	26
405	8	37	37	25
	48	10	68	20

INSTITUTION CODE & NAME	TOTAL # OF RESEARCHERS	% holding as highest degree: BS DEGREE	MS DEGREE	PhD DEGREE
500 UNI -- Universities				
501	5	60	20	20
502	56	0	10	89
503	34	17	0	82
504	11	0	18	81
505	23	8	8	82
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	129	8	8	82

SUDAN ATMS Human Resources Inventory

Table 3: Distribution of Work by Institution

01/30/88
Page 1

101 ARC -- Abu Naamu Research Station

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	90	5	1	3	1	17
	85	10	2	2	1	17
	50	40	4	0	6	23
	80	10	5	0	5	10
	0	10	10	80	0	7
	80	5	5	10	0	12
	80	5	5	5	5	9
	95	3	2	0	0	7
	90	3	5	1	1	11
	90	10	0	0	0	10
Averages:	74	10.	3	10	1	12

Number of Employees: 10
Average Age: 37

102 ARC -- Fisheries Research Station (Port Sudan)

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	80	5	5	5	5	13
	40	40	5	5	10	17
	20	50	5	5	20	16
	80	5	5	5	5	10
Averages:	55	25.	5	5	10	14

Number of Employees: 4
Average Age: 39

103 ARC -- Fisheries Research Station (Shigara)

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	60	20	12	4	4	16
	70	5	25	0	0	8
	50	5	25	15	5	15
	100	0	0	0	0	10
	60	10	30	0	0	11
	70	10	10	0	10	22
Averages:	68	8.3	17	3	3	13

Number of Employees: 6
Average Age: 39

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
104 ARC -- Food Processing Research Center						
	80	0	10	5	5	17
	60	10	20	5	5	1
	70	10	15	3	2	16
	70	10	10	5	5	16
	70	20	10	0	0	16
	80	15	5	0	0	15
	50	25	10	5	10	22
	50	20	20	5	5	15
	60	25	10	5	0	16
	70	15	10	5	0	15
	60	10	10	10	10	14
	80	10	5	3	2	18
	60	10	20	10	0	14
	100	0	0	0	0	14
	30	70	0	0	0	14
	80	10	4	5	1	20
	70	5	20	2	3	11
	50	30	10	10	0	21
	60	10	10	10	10	15
	70	6	20	2	2	14
	50	20	15	10	5	19
Averages:	65	16.	11	4	3	15

Number of Employees: 21
Average Age: 39

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
105 ARC -- Forestry Research Station (Soba)						
	70	20	5	0	5	23
	70	30	0	0	0	7
	90	10	0	0	0	11
	75	25	0	0	0	21
	40	30	20	5	5	20
	90	5	3	0	2	9
	90	7	1	0	2	11
	95	0	0	0	5	10
	90	10	0	0	0	11
	75	15	10	0	0	11
Averages:	78	15.	3	0	1	13

Number of Employees: 10
Average Age: 38

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
106 ARC -- Gezira Research Station						
	100	0	0	0	0	2

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
		Percent of Time Spent on:				
	50	10	30	5	5	29
	55	45	0	0	0	20
	70	20	5	0	5	27
	100	0	0	0	0	2
	92	0	5	2	1	18
	100	0	0	0	0	22
	100	0	0	0	0	11
	80	0	20	0	0	23
	85	10	0	0	5	4
	96	1	1	1	1	27
	70	20	4	5	1	26
	90	5	0	0	5	5
	100	0	0	0	0	14
	70	20	5	4	1	23
	95	5	0	0	0	25
	85	0	10	0	5	27
	95	0	0	0	5	29
	75	20	4	0	1	11
	45	5	30	7	13	5
	70	15	3	10	2	25
	50	25	15	5	5	27
	100	0	0	0	0	4
	100	0	0	0	0	2
	65	35	0	0	0	2
	75	10	5	5	5	27
	0	0	100	0	0	2
	50	15	30	0	5	28
	100	0	0	0	0	2
	100	0	0	0	0	13
	60	30	5	5	0	20
	100	0	0	0	0	2
	70	5	20	2	3	4
	100	0	0	0	0	13
	95	0	3	1	1	18
	100	0	0	0	0	2
	10	80	7	1	2	31
	90	10	0	0	0	8
	65	3	25	1	6	3
	90	5	2	1	2	15
	40	5	50	0	5	4
	80	10	10	0	0	23
	25	60	0	10	5	27
	100	0	0	0	0	2
	85	5	10	0	0	19
	100	0	0	0	0	2
	85	10	0	0	5	4
	75	15	5	0	5	22
	65	10	5	5	15	29
	85	10	0	0	5	5
	100	0	0	0	0	12
	100	0	0	0	0	2
	90	10	0	0	0	7
	70	20	0	2	8	29

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	80	15	5	0	0	19
	85	10	0	0	5	4
	0	0	0	0	0	12
	99	0	0	1	0	21
	70	20	4	4	2	28
	75	5	10	5	5	28
	30	50	10	5	5	28
	88	2	4	5	1	12
	75	10	5	5	5	34
	100	0	0	0	0	12
	90	5	0	5	0	17
Averages:	77	10.	6	1	2	15

(Column headings RESEARCH through TRAVEL/CONF. are printed under "Percent of Time Spent on:")

Number of Employees: 65
Average Age: 39

107 ARC -- Guneid Research Sub-Station

	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	100	0	0	0	0	11
	100	0	0	0	0	23
	80	3	10	4	3	27
	40	40	5	5	10	26
	100	0	0	0	0	12
Averages:	84	8.6	3	1	2	19

Number of Employees: 5
Average Age: 42

108 ARC -- Hudeiba Research Station

	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	90	3	3	2	2	18
	75	10	5	5	5	10
	85	5	5	3	2	15
	50	10	15	20	5	16
	80	10	2	8	0	16
	90	10	0	0	0	12
Averages:	78	8.	5	6	2	14

Number of Employees: 6
Average Age: 38

109 ARC -- Kadugli Research Station

	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	40	58	1	0	1	4
	60	25	5	5	5	5
	88	0	2	5	5	6
	90	8	0	1	1	10

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	95	0	0	0	5	2
	90	10	0	0	0	8
	100	0	0	0	0	6
	70	10	10	7	3	9
Averages:	79	14.	2	2	2	6

Number of Employees: 8
Average Age: 34

110 ARC -- Kassala Research Station

	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	70	25	1	4	0	19
Averages:	70	25.	1	4	0	19

Number of Employees: 1
Average Age: 43

111 ARC -- Matug Research Station

	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	90	6	1	1	2	12
Averages:	90	6.	1	1	2	12

Number of Employees: 1
Average Age: 37

112 ARC -- New Halfa Research Station

	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	89	0	5	5	1	8
	75	0	10	10	5	18
	89	0	5	5	1	13
	70	5	5	10	10	16
	90	0	5	0	5	23
	50	25	5	15	5	21
Averages:	77	5.	5	7	4	16

Number of Employees: 6
Average Age: 41

113 ARC -- Obeid Research Station

	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	100	0	0	0	0	12
	97	0	0	0	3	6
	90	2	3	3	2	14
	80	0	0	0	20	4
	80	10	0	5	5	9

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	---------- Percent of Time Spent on: ---------------					
	60	20	10	10	0	10
	60	25	5	5	5	20
	100	0	0	0	0	7
	80	10	5	0	5	14
	85	0	10	0	5	10
	80	20	0	0	0	8
	80	10	4	4	2	9
Averages:	82	8.1	3	2	3	10

Number of Employees: 12
Average Age: 36

114 ARC -- Rahad Research Station

	80	0	10	10	0	12
	80	0	0	20	0	17
	80	5	5	10	0	15
	25	70	0	5	0	14
	80	5	10	5	0	14
Averages:	69	16.	5	10	0	14

Number of Employees: 5
Average Age: 41

115 ARC -- Sennar Research Station

	90	5	5	0	0	19
	96	0	2	0	2	20
	50	46	1	3	0	19
	100	0	0	0	0	14
Averages:	84	13.	2	0	0	18

Number of Employees: 4
Average Age: 42

116 ARC -- Shambat Research Station

	100	0	0	0	0	21
	100	0	0	0	0	28
	90	5	5	0	0	12
	85	5	5	4	1	18
	98	0	0	0	2	21
	60	10	0	0	30	34

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	-----	-----	-----	-----	-----	-----
Averages:	88	3.3	1	0	5	22
Number of Employees: 6						
Average Age: 46						
117 ARC -- Shendi Research Station						
	97	0	1	1	1	16
	90	10	0	0	0	19
	-----	-----	-----	-----	-----	-----
Averages:	93	5.	0	0	0	17
Number of Employees: 2						
Average Age: 40						
118 ARC -- West Sudan Research Headquarters						
	0	92	0	0	8	28
	-----	-----	-----	-----	-----	-----
Averages:	0	92.	0	0	8	28
Number of Employees: 1						
Average Age: 52						
119 ARC -- Wildlife Research Center (Khartoum)						
	90	10	0	0	0	11
	50	20	20	5	5	20
	60	15	15	10	0	17
	80	20	0	0	0	11
	80	10	5	0	5	13
	70	0	30	0	0	20
	90	10	0	0	0	11
	70	0	30	0	0	17
	-----	-----	-----	-----	-----	-----
Averages:	73	11.	12	1	1	15
Number of Employees: 8						
Average Age: 39						
201 APVR -- El Huda Animal Products						
	40	30	20	5	5	19

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
Averages:	40	30.	20	5	5	19

Number of Employees: 1
Average Age: 42

202 APVR -- Soba Veterinary Research Laboratory

	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	60	25	15	0	0	18
	60	20	20	0	0	27
	60	12	20	0	8	28
	60	5	30	3	2	34
	70	15	15	0	0	21
	60	10	20	5	5	23
	70	20	5	0	5	24
	75	8	10	2	5	28
	70	10	10	5	5	17
	80	10	5	3	2	20
	50	30	10	10	0	21
	70	15	10	2	3	25
Averages:	65	15.	14	2	2	23

Number of Employees: 12
Average Age: 48

203 APVR -- Strukaba Animal Products

	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	50	25	15	5	5	17
	100	0	0	0	0	12
	70	15	5	10	0	8
Averages:	73	13.	6	5	1	12

Number of Employees: 3
Average Age: 37

204 APVR -- Um Benien Animal Products Research

	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	40	60	0	0	0	9
Averages:	40	60.	0	0	0	9

Number of Employees: 1
Average Age: 34

301 NRC -- Economic and Social Research Council

	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	80	10	5	0	5	12

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	75	15	2	5	3	10
	70	30	0	0	0	11
	85	10	0	0	5	15
	85	15	0	0	0	11
	70	15	5	0	10	14
Averages:	77	16.	2	0	3	12

Number of Employees: 6
Average Age: 39

302 NRC -- Agricultural Research Council

	20	78	0	0	2	13
	40	42	10	3	5	12
	10	60	20	0	10	9
Averages:	23	60.	10	1	5	11

Number of Employees: 3
Average Age: 38

401 PI -- Abu Haraz

	10	25	60	3	2	9
	20	60	10	10	0	26
	50	10	30	10	0	16
	0	30	50	20	0	10
	10	30	60	0	0	11
	0	30	60	0	10	11
	15	20	60	5	0	13
	5	25	65	5	0	8
	20	10	60	5	5	10
Averages:	14	27.	50	6	1	12

Number of Employees: 9
Average Age: 36

402 PI -- Abu Naamu

	15	20	60	5	0	9
	30	10	60	0	0	12
	20	30	50	0	0	10
	0	60	20	0	20	17
	20	20	60	0	0	9
	25	10	65	0	0	10

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
Averages:	18	25.	52	0	3	11

Number of Employees: 6
Average Age: 37

403 PI -- Koko

	100	0	0	0	0	12
	10	30	40	10	10	15
	0	0	100	0	0	11
	0	40	50	0	10	10
	10	20	70	0	0	18
	25	25	50	0	0	9
	20	30	40	10	0	15
	0	25	50	5	20	14
	0	10	5	85	0	9
	0	68	5	25	2	16
Averages:	16	25.	41	13	4	12

Number of Employees: 10
Average Age: 39

404 PI -- Shambat

	0	40	60	0	0	2
	10	10	60	10	10	28
	10	30	60	0	0	17
	0	40	60	0	0	8
	25	18	50	5	2	21
	15	50	25	5	5	14
	10	0	85	0	5	16
	15	0	85	0	0	16
	15	10	70	5	0	22
	10	20	50	10	10	9
	30	10	50	5	5	13
	30	0	60	0	10	18
	0	30	65	5	0	2
	10	40	50	0	0	21
	10	40	0	50	0	20
Averages:	12	23.	55	6	3	15

Number of Employees: 15
Average Age: 41

405 PI -- Soba

	0	0	100	0	0	4

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	0	25	70	5	0	21
	0	5	85	0	10	9
	0	0	100	0	0	21
	0	10	80	10	0	21
	10	15	70	5	0	17
	0	10	90	0	0	11
	0	80	15	0	5	25
Averages:	1	18.	76	2	1	16

Number of Employees: 8
Average Age: 40

501 UNI -- Department of Agricultural Engineering

	60	25	15	0	0	2
	75	0	25	0	0	4
	75	5	15	2	3	9
	21	40	31	0	8	16
	75	5	15	2	3	4
Averages:	61	15.	20	0	2	7

Number of Employees: 5
Average Age: 33

502 UNI -- Faculty of Agriculture

	30	0	65	0	5	18
	0	0	100	0	0	28
	25	10	60	0	5	17
	20	15	45	10	10	5
	40	10	45	2	3	12
	30	10	40	10	10	30
	40	30	30	0	0	15
	15	15	60	0	10	15
	40	10	40	10	0	16
	50	0	45	0	5	11
	40	15	40	0	5	8
	30	30	40	0	0	20
	30	10	45	10	5	21
	35	10	50	5	0	13
	40	10	50	0	0	20
	30	10	50	0	10	9
	25	5	65	0	5	13
	30	5	10	50	5	15
	100	0	0	0	0	9
	20	5	10	60	5	16
	40	5	50	0	5	26
	40	10	40	5	5	31
	30	5	60	0	5	15

INSTITUTION CODE AND NAME	RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	0	100	0	0	0	5
	25	20	30	20	5	7
	0	0	100	0	0	11
	40	20	15	15	10	18
	30	30	40	0	0	17
	30	15	20	30	5	4
	65	5	20	5	5	5
	30	0	70	0	0	14
	50	0	50	0	0	10
	15	5	75	0	5	15
	30	20	40	10	0	4
	55	5	40	0	0	19
	40	10	45	0	5	13
	60	5	25	9	1	16
	60	0	40	0	0	18
	30	5	60	5	0	6
	50	0	50	0	0	9
	25	10	12	45	8	17
	20	10	60	0	10	19
	70	0	25	0	5	13
	30	0	20	50	0	15
	50	0	50	0	0	15
	50	0	50	0	0	2
	25	10	65	0	0	23
	30	0	60	10	0	15
	50	0	50	0	0	13
	30	10	50	10	0	16
	50	0	0	50	0	23
	50	0	50	0	0	9
	12	30	35	3	20	17
	47	15	30	5	3	14
	20	0	60	5	15	15
	30	20	40	10	0	14
Averages:	35	10.	43	7	3	14

Number of Employees: 56
Average Age: 40

503 UNI -- Faculty of Veterinary Science

	50	30	20	0	0	21
	30	15	40	10	5	12
	20	30	50	0	0	13
	20	10	60	10	0	35
	30	0	65	0	5	3
	40	10	30	10	10	22
	30	25	35	0	10	15
	50	10	30	5	5	21
	50	10	35	0	5	15
	25	25	35	0	15	17
	40	10	40	5	5	16

INSTITUTION CODE AND NAME	Percent of Time Spent on: RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	40	10	50	0	0	12
	45	15	30	5	5	25
	45	5	50	0	0	6
	40	5	40	10	5	14
	75	25	0	0	0	21
	25	0	75	0	0	12
	0	0	100	0	0	4
	50	0	46	0	4	1
	65	35	0	0	0	9
	30	10	50	9	1	11
	20	20	50	5	5	16
	20	10	60	5	5	25
	0	59	40	0	1	6
	30	30	15	15	10	25
	40	10	30	0	20	9
	50	0	50	0	0	6
	40	20	25	5	10	17
	30	60	10	0	0	21
	50	10	30	5	5	15
	0	0	100	0	0	1
	10	0	80	5	5	26
	50	0	0	50	0	14
	75	10	15	0	0	6
Averages:	35	15.	40	4	4	14

Number of Employees: 34
Average Age: 41

504 UNI -- Institute of Animal Production

	50	15	35	0	0	16
	40	20	20	20	0	2
	55	5	25	10	5	4
	35	0	25	25	15	30
	30	30	40	0	0	9
	30	30	40	0	0	15
	65	0	35	0	0	6
	40	10	50	0	0	9
	40	10	40	10	0	18
	50	0	25	24	1	6
	30	20	30	10	10	36
Averages:	42	13.	33	9	2	13

Number of Employees: 11
Average Age: 41

505 UNI -- University of Gezira

	20	10	60	5	5	15

INSTITUTION CODE AND NAME	Percent of Time Spent on: RESEARCH	ADMINISTRATION	TRAINING	EXTENSION	TRAVEL/CONF.	NUMBER YEARS WORK EXPERIENCE
	60	20	5	10	5	20
	10	0	60	5	25	12
	25	0	75	0	0	19
	20	45	20	10	5	23
	6	2	90	1	1	13
	40	10	40	10	0	16
	0	0	100	0	0	9
	25	25	0	45	5	14
	100	0	0	0	0	3
	30	10	50	5	5	9
	35	15	40	10	0	14
	80	0	20	0	0	11
	25	25	45	0	5	16
	20	0	70	0	10	11
	100	0	0	0	0	9
	20	25	50	0	5	15
	30	10	40	10	10	15
	0	0	100	0	0	3
	20	10	70	0	0	14
	50	0	40	0	10	21
	0	0	100	0	0	8
	45	20	30	0	5	12
Averages:	33	9.9	48	4	4	13

Number of Employees: 23
Average Age: 39

SUDAN ATMS Human Resources Inventory

Table 4: List of Research Projects by Institute

01/30/88
Page 1

INSTITUTION CODE AND NAME	DESCRIPTION OF RESEARCH PROJECTS
101 ARC -- Abu Naamu Research Station	
	National sunflower varieties
	Screening of sorghum material for resistance to different pests
	Agronomic practices of sorghum
	Development of drought resis. sesame varieties
	Effect of two sowing methods on sorghum yield
	Variety improvement
	Effect of soil acidification on sesame response to NPK
	Eff.of chem. seed dres. on emerg., pre-&post-em. seedl. soybeans
	Assessment of damage caused by weeds
	Screening of local & introduced sesame for tolerance to P. sesami
	Differential response of different varieties of crop to different hebicide
	Effect of sowing date of crops on pest population dynamic
	Agronomic practices of maize
	Development of high yield. sesam. var. for high rain areas
	Effect of two implements on land preparation yield of sorghum
	Striga resistance
	Introduction of fodder crops
	Cultural practices for control & striga
	Soil moisturre conservation
	Sesame on-farm trials
	Effect of plant population on efficiency of siga binder on kenaf harvesting
	Pathogenic causes of poor stand of peanut
	Striga control
	Effect of different seedbed preparation of sowing methods on weed.
	Effect of phosphorus rate of method of application sesame yield & P uptake
	Effect of N & P on sesame
	Sunflower cultural practices
	Soyabeans cultural practices
	Sesame sawing, fertilizer, etc.
	Effect of combination of shelling insecticide, fungicide on peanut emerg.
	Crop rotations
	Collecting - preserving sesame sperplasm
	Population crop performance
	Screening local sorghum var. & crosses for tolerance to charcoal rot.
	Varietal & chem. screening for control of A-helianthi of sunflower
	Mechanical harvesting of sesame
	Screening cotton seed dressings against fleabeatle
	Agronomic practices of cotton
	Development of improved shorth. ses. var. for mech. harvesting
	Residual analysis and effect of herbicides on subsequent crops
	Effect of N rate and time of application on sesame yicid and NP take
	Economic analysis
	Screening for selective herbicides in sorghum sesame sunflower, soybean
	Eff. of irrig. freq. on charcoal rot incidence

INSTITUTION CODE AND NAME	DESCRIPTION OF RESEARCH PROJECTS
	Developement of short duration sesame varieties
102 ARC -- Fisheries Research Station (Port Sudan)	
	SUDAN IDRC oyster culture
	Sudan IDRC oyster culture.
	ALESCO coastal oceanography
	Sudan IDRC project
	ALECSO coastal oceanography
	ALESCO coastal ocean
	ALESCO artificial breeding of oysters
	ALESCO coastal oceanography
	ALECSO artificial breeding of oysters
	ALESCO artificial breeding
	Local shrimp survey project
	Sudan IDR oyster project
	ALESCO Artificial breeding oyster
103 ARC -- Fisheries Research Station (Shigara)	
	Optimum levels of chicken manure & triple superphosphate fertilizers
	Oyster culture research project
	Influence of Gebel Aulia reservoir on distribution plankton in white Nile
	Fish and meat studies
	Assessment of Jebel Aulia resevoir fisheries
	Parasitic survey on fish fauna at Jebel Aulia reservoir on prelev.&pathol.
	Studies on the population dynamics of some commercial Nile fishes
	Investigation of pupulation characteristics of cyprinid fish N & S Jebel
104 ARC -- Food Processing Research Center	
	Feasibility and viability of production of single cell protein from molasse
	Project on faba beans, human nutrition in Sudan
	Tomato variety improvement
	Export of fresh vegetables from Sudan
	Drying and dehydration of baladi lime
	Solar driven cold store project
	Formulation of dehydrated foods from edible groundnut cake
	Aflatoxin of some sudanese products
	Storage of oranges
	Biochemistry & microbiology of gum arabic
	Feasibility studies
	Composite flour
	Quality evaluation of food legumes in Sudan
	Effects of MH on onion storage
	Reduction of handling and storage losses in food grains in Sudan
	Utilization of unconventional proteins
	Post harvest physiology of fruits and vegetables
	Increased use of sorghum
	Utilization of oil seeds for formulation of dehydrated recepies
	Nasha Baby food
	Physiological studies of crops
	Protein quality of local legumes

INSTITUTION CODE AND NAME	DESCRIPTION OF RESEARCH PROJECTS
	Upgrading of tradition technologies
	Effect some plant extract on bacteria
	Respiration of fruits and vegetable
	Preservation of fruit concentrates
	ICARDA/IFAD nile valley project on faba beans
	Post harvest losses of fruits and vegetable
	Preparation of carbonated beverages from local fruits
	Quality assessment of faba beans
	Onion storage
	Estimation of post harvest losses of crops
	Loss assessment of major horticultural crop
	Quantification of sudanese texture awareness on faba beans
	Quality assessment of peasto
	Post-harvest losses of fruits and vegetables
	Studies on proteins of new groundnut cultivars
	Banana ripening
	Cereal supplemented food
	Studies on Karkadeh seed proteins
	Solar drying of tomato slices
	Kellogs energy food
	Processing quality of crushed karkadeh
	banana ripening
	Formulation and stability of diabetic jams
	Production of tomato paste from dehydrated tomatoes
	Studies on Lupin seed proteins
	Storage of potatoes
	Screening of new sorghum varieties for trad. used
	Solar driven cold store project
	Improvement of tradition. methods of drying in Sudan
	Poising
	Kisra Development
	Storage of winter produce vegetable
	Mango storage
	Oil seeds storage
	Microbiological studies of dairy products produced in Khartoum province
	Post harvest losses of fruit & vegetables
	Composite flour products
105 ARC -- Forestry Research Station (Soba)	
	Browse legumes / evaluation of their nutritive values
	Study of exotic flora at soba
	Viscosity study of gum arabic
	Wood preservation
	Biomass estimation for energy
	Vegetative propagation of some specis of family capparidaceal
	Nursery management practices
	Study of seed characteristic of Sudan trees & shrubs
	Testing some sudanese wood species for using as spare parts for text.mach.
	Wood for energy
	Wood for particleboard
	Building up forestry res. herbarium at soba
	Study of gum producing plants

INSTITUTION
CODE AND NAME   DESCRIPTION OF RESEARCH PROJECTS

Study of propagation of forest trees vegetatively
Agrosforesty
Tree species for biomass production for energy
Building up of forestry herbarium
Treespecies and provenances trials
Land reclamation project
Mesquito project
Vegetative propagation of acacia senegal, using rooting hormones
Building up of forestry res. herbarium
Wood anatomy of sudaness spp
Evaluation of Eucalyptus wood
Effect of growth regulators and rhizobium on seedling of acacia
Mechanical properties of wood

106 ARC -- Gezira Research Station

Evaluation of newly introduced forages
Fusarium wilt of cotton
Distribution of major pestsin gezira
Susceptibility of various crops to promising herbicides
Variety and irrigation expt
Disease in Collin, tomato
Development of new sorthum cultivar
Cotton Bacterial
Cotton agronomy
Effect of insects on cotton root rot
Pathogenic wilt in collin
Cotton and land preparation and flooding expt
Effect of agrochemical on soil is biological activity
Fertilizer Expt
Sorghum smut diseases
Wheat genotypes irrigation expt
Breeding for drought T
Breeding cotton
Weed control in Groundnut
Casauvina species seedling growth
Brighetting of cotton stalks / energy source
A; nilotica seed testing
Residue of pesticide in cotton seeds, folliage and soil
Herbicide evaluation in cotton
National citrus virus , fre budwood certif. program
Improvement of banana production in central Sudan
Economic evaluation of on farm and back up research in wheat study
Powderymildew on some selected vegetables
Groundnuts fertilizers trial
Collaborative research support programme (Alabama / ARC)
Evaluation of impact of different cropping systems
Okra seeds storage experiment
Scarcening of cotton
Grain sorghum legume mixturre
Aquatic weed control by chemical
UNEP/AGFUND increase of leg. protein through BNF
Breeding for insect and diseas resistance

INSTITUTION CODE AND NAME	DESCRIPTION OF RESEARCH PROJECTS
	Eucalyptus species trials
	Developœent of resistant cultivar to striga
	Soil salarization
	Cultivar iœproveœent in wheat
	Groundnut breeding developœent
	Effect of sowing dates on yields of soybeans
	Screening of selected toœato
	Evaluation of insecticides for control of jassids on eggplant
	Research on wheat, faba bean, cotton, sorghuœ
	Effect of herbicides on biological activity
	Sudanese flora as source of useful natural products
	Striga biology and control
	Chairœan œanageœent coœœittee pilot farœs
	Application of insecticides
	Stickiness on cotton lint
	Cotton land preparation flooding expt
	Breeding disease resistance in toœato
	Susceptibility of cotton cultivar to leaf virus disease
	Control of terœites on hot pepper
	Effect of hebicides on groundnut Rhizobiuœ association
	Socio econoœic surveys for sorghuœ production in Sudan
	Application of pesticides
	Groundnuts varietal trial
	Oilseeds project IDRC/ARC
	Prediction of cottong field in terœs of various inputs
	Characterization, œultiplication & docuœentation of horticultural gerœplasœ
	Screening of toœato
	Sudan grass leguœe œixturre
	Biological studies on aquatic weeds
	ICARD/IFAD/NVP on fababean (BNF)
	Iœproveœent of œediuœ staple cotton
	Research œanageœent
	E œicrotheca provenances trials
	Production œodeling for irrigated subsectors
	Screening of insecticides for cotton pests
	Dosage œentality studies on jassia
	Insects of groundnuts
	Radiotracer - aided techniques in pesticide residues
	On farœ verification trial
	Groundnut cultivars for rainfed and irrigated areas
	Wheat fertilization expt
	Screening of okra
	Evaluation of insecticides for control thrips on onion
	Training
	Use of 15 N enriched area to study N2 fixation by groundnut
	Optœ growing conditions for soœe œedicinal and aroœatic phs
	Dosage œentality studies on aœerican boll.
	Proœotion of bee keeping
	Faba bean sowing dates expts
	Hageen dura fertilizer expt
	Iœproveœent of potato production
	Striga control in sorghuœ
	Screening of insecticides for control of cotton pests

INSTITUTION CODE AND NAME	DESCRIPTION OF RESEARCH PROJECTS
	Coordination of wheat research in sudan
	Herbicides persistence
	Folliar fertilizer
	Seed dressing trial
	Nematology survey
	Screening of tomato cultuvar against root knol nematodes
	Biology & ecology of the african melon ladybird
	Breeding for charcoal
	Screening of pesticides for commecial use
	Wheat genotypes irrigation expt
	Tapping nautra
	Micronutrients spray trials on fruit crops
	Disease survey on wheat
	Factors affecting groundnuts fild
	Estimation of cumulative residual and direct effect of fertilizers
	Seed dormancy breaking procedures
	Varietal adaptation of soybean and sunflower in gezira
	Weeds control of vegetable crops
	Other duties
	Citrus diseases
	Citrus research
	Nitrogen uptake and metabolism in cultit. crops
	N assay of BNF by forages
	A; seyal growth
	Foliar diseases of sorghum
	Breeding for Grain quality
	Weed control in sorghum
	Bionomic of the cotton whilefly
	Wheat phosphorus nutrition
	Integrated pest control pilot areas in Gezira
	Reevaluation of Guneid soil for sugarcane production
	Breeding for grain yield
	Potassium status of some Gezira soils
	H dura variety and irrigation expt
	Collection of germ plasm
	Perennial weed control
	Improvement of citrus production in central Sudan
	Policy analysis of Gezira scheme
	Aflatoxin on groundnut
	Effect of missing irrigation on grounnut
	Groundnuts
	Time series of meteorol. data
	Chemical analyses of horticultural germplasm
	Interruption of primary growter of forage legumes
	Evaluation of herbicides
	Use of is N to determine NF by groundnut
	A nilatica of A tortilis species trials
	On farm verification trial
	Sorghum charcoal rat
	Purification and evaluation of hot pepper
	Nursery improvement program for fruit crops
	Effect of foliar fertilizers on cotton
	Mode of action of some hebicides

INSTITUTION CODE AND NAME	DESCRIPTION OF RESEARCH PROJECTS
	Effects of treated water on rational crops
	Soybean yield trial expt
	Effects of application time on hebicide performance
	Chairman steering committee for pilot farm
	Wheat water stress expt
	Biological Ecol. investigation on H. armigera
	Dosage mentality tudies on white fly
	Cotton pest management
	Residues of insecticides in Cotton products and soil
	Time of initiation of control heliothis armigra
	Intro of faba beans in gezira
	Potato improvement project
	Curation of insects
	Fusarium wilt of cottong
	Wheat agronomy
	Tomato resistane to leafcurl virus
	Sugars and stickiness in cotton
	Diseases of vegetable crops in sudan
	Other vegetables
	agrochemicals and cotton wilt
	Tenancy structurre at Gezira scheme
	Herbicide screening in vegetables
	Member of Gezira rehabilitation program
	Effect of insects on forage crops
	Crop pests of potato
	Rot resistance
	Soil and Plant testing for cotton ingezira sheme
	Wheat water stress expt
	Studies on natural enemies of cotton pests
	ARC/FAO research fertilizer Program
	Verification of improfed wheat production technol. in farmers fields
	Vegetable crops improvement project
	Studies on parasites and predators of major crop pests
	Resistance of cotton plant whitefly attack
	Fababean irrigation expt
107 ARC -- Guneid Research Sub-Station	
	Re-evaluation of auneid soil potentialities
	Evaluation of sugarcane characteristics for mechanical harvesting
	Intercropping legumes with s.cone
	Testing of same frigicides for sumut control
	Determination of time dosage rate and method of application of heb.
	Screening of hebicides for weed culturre
	Hilling-up expt.
	Reclamation of sodic soil
	National fertilizer expt
	Re evaluation of guineid soil
	Nutritional requirement of sugarcane
	Response of sugarcane crop to diff. tillage treatments
	Evaluation of disease resistance of sugarcane varieties
	Disease surveys
	Development of sugarcane crop log system in Sudan

INSTITUTION
CODE AND NAME DESCRIPTION OF RESEARCH PROJECTS

Estimation of water use by sugarcane
methods of planting
Introduction of disease resistant varieties
National variety trials

108 ARC -- Hudeiba Research Station

Control and post harvest losses due to insects in legumes and dates
Vegetable seed production
Tomato breeding + potato
Effect of NP fertilizer on pulses of wheat
Control of faba bean pests
Onion breeding
Effect different water duties and interval on plant yield
Ecological studies on pests of legumes
Medicinal and aramatic plants
Promotion of lentils production in Nile province
Agronomy of vegetable crops mainly tomatoes onions potatoes
Ecological studies on wheat aphids
Peas and green beans breeding
Wheat breeding chickpea and lentil breeding
Agronomic cultural practices on chick pea, dry beans, lentils faba beans
Ecological studies on fruittrees

109 ARC -- Kadugli Research Station

Phosphorous supplementation for lactating cows
Transhumant calve suckling regimes
Forage legume production
Study of communal work group
Husbandry managementpractices of livestock
Poisonus pasture plants
Financial ability of traditional farmers to purchase fertilizers
Annual reserach agronomy program Kadugli Research station
Sillage making and feeding
Milk production & marketing among transhumants
Control breeding program for sedentary cattle at nuba mountains
Transhumant milk production and marketing decisions in South Kardofan
Follow-up of on farm trials
Suckling behaviour and calf rearing and weaning practices
Nafir labour in south kordofan
Control breeding program for transhumant 'Baggara' sheep
On-farm verification agronmy trials with global 2000 inc. kadugli station
Diagnostic surveys
Diet selection by cattle
Productivity and fitness of kanana, butana cattle
Annual research agronomy programs for Nuba mountain development project
Distribution of improved sorghum & its adoption rate in south kardofan
Up grading of sedentary sudanese desert goats using sudanese nubian

110 ARC -- Kassala Research Station

Water spreading of seasonal streams

INSTITUTION
CODE AND NAME DESCRIPTION OF RESEARCH PROJECTS

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Introducing veget. crops in Gash Delta
Improving veget. production in Tokar Delta

111 ARC -- Matug Research Station

Minimum tillage & weed control methods for differ. crops under rain irrigat
Mechanical sowing methods and seedrates for different crops
Mechanical picking & stripping of cotton under rainfed conditions
Investigations in labour & machinery requirements for gegira schemes
Effect of tillage systems & implement. types on crops yield
Mechanical harvesting of sorghum

112 ARC -- New Halfa Research Station

On farm trials on rational field crops
Project related to integrated pest control
Wheat stem disease
Citrus variety trials
ICARDA nile valley project on faba beans
Data plam variety trials
Vegetable diseases
Collecting informations from previous datas
Diseases of fruit trees in new halfa
Wheat improvement
Research on various aspects of integrated pest control
Chemical weed control in groundnut
Potato variety trials
OPEC/ICARDA fund for wheat
Chemical Weed Control in Cotton
Improvement of banana production
On farm trial on field crops
General survey of all crops and weeds
Food legumes practices and studies
Wheat diseases! survey
Research on groundnuts cotton sorghum
On farm research and extension
Grape variety trials
Weed competition in wheat

113 ARC -- Obeid Research Station

Use of organic inorganic soil amendements to improve the phys soil condit.
Soil & water management
Factors affecting spatial variability and millet growth in sandy soils
Breeding of Roselle Kerkadi
Water harvesting techniques
Gum production from coppice regeneration of A-Senegal
Effect of seed bed and irrigation interval on onion
Breeding of pearl millet
Intercropping
Growth charact. and survival rates of acacia senegal
Planting millet genotypes for identification varieties resistant to borers
Plant spacing trials on tomato sweet pepper and eggplant

INSTITUTION
CODE AND NAME   DESCRIPTION OF RESEARCH PROJECTS

Improvement of native pasture through ammoniation
Phenology and natural regeneration of acacia senegal
Effect of mecha. range improvt. tech. in north kornofan
Wind erosion control
Spacing and population density studies
Breeding of miscellaneous crops
Drought tolerance of crops
Intercropping of A-Senegal with local var. of sorghum, millet groundn.sesam
Breeding of sorghum
Crop sequence
Gard. soil reclamation
Water use efficiency of crops in western Suan
Sheep husbandry and nutrition
Variety trials (tomato, sweet pepper, eggplant, onion, okra, peas, beans.
Range breeding and plant intro and evaluation
Collaborater in on-farm trials
Transfer of technology and on-farm res.
Coordinator of the sedentary system (field crops) reserach
Effect of cultivar NP ertilization on nutrition & yield of millet sorthum
Groundnut improvement program
NP fertilizer trials on tomato sweet pepper and eggplant
Priminary study of the chemical & physical of the main soil types of Kordof
Effect of time of tapping intensity on amount of gum produced by A-senegal
Acacia senegal provenance research
Supplementation of dry period feeding by legume residues
Effect of intra rwo spacing and farm yard manure on watermelon production
methods, time and rate of fertilizer applic.
Agro forestry

114 ARC -- Rahad Research Station

Economic thresholds in cotton
Tomato improvement program
Tillage on cotton & groundnuts
Design of stailk raker
Determination of economic threshold of white fly on cotton
Evaluation of two dosage rates of drawin against insect pests on cotton
Nonety trial
Plant population and growth system
Herbicide screening
Cotton water relation
Forage and Maize
Mechanical cotton picking
Herbicide screening
Effect of plant density on white fly population
Onion and garlic improvement
Efficacy of some currently used chemicals against cotton pest
Harvesting of groundnuts
Economic thresholds G/N & cotton
Abundance & distribution of insect pests on two varieties of cotton
Faba bean improvement
Cotton fertilization
Design of hand planter

INSTITUTION CODE AND NAME	DESCRIPTION OF RESEARCH PROJECTS
	Weed competition in cotton
	oil crops
	Watermeloen improvement
	Biological studies on cotton
	Mechanization of faba beans
115 ARC -- Sennar Research Station	
	Production of cucurbit crops
	Sorghum variety & population evaluation
	Purification and improvement of hot pepper
	Studies on the life cycle of lirimyza tufolii bury
	Breeding for resistance to powdering mildew in tomatoes
	Groundnuts cultivar evaluation under irrigated conditions
	Cotton water management
	Pumpkins purification and improvement
	Introduction of new cash crops into the heavy clays eg. chickpea,cowpea,etc
	Effects of arhids and powdery mildew on olga yield
	Introduction of faba beans into the heavy clans of central Sudan
	Effects of seed dressing on flea beatle incidence on kerkad
	Tomato improvement program
	Improvement of spices medicinal and aromatic crops
	Studies on the ecology of Lirimyza trifo lu on broad bean
	Economic importance of aphids on winter soun watermelon
	The economic importance of Lirimyza trifolu on broad bean
	Breeding for resistance to tomato leaf virus disease
	Cotton variety and nitrogen studies
	Production of bulb crops onion and garlic
116 ARC -- Shambat Research Station	
	Evaluation of vegetable insecticides in the fields
	Insects and Diseases of Potatoes
	Weed control in tomatoes
	Studies on chemical weed control in potatoes
	Problems dealing with production tomato, onion, potatoes, peas, & beans
	Research coordinator, do not conduct research hisself
	National Potato Variety Trial
	Seedling tubers (potatoes)
	Weed control in Onions
	Evaluation of neem for the control of vegetable pests
	Lentils
	Biology, Ecology and control of stronge pests. Loss assessment
	Cultural Aspects of Potatoes
	Control of Orobanche (parasitic weed) on Vegetables
	Sweet pepper powdery mildew
	Control of striga (parasitic weed) on Sorghum
	Integrated control of potato pests
	Weed control in Faba beans
	Chickpea Production Aspects
117 ARC -- Shendi Research Station	

INSTITUTION
CODE AND NAME   DESCRIPTION OF RESEARCH PROJECTS
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OPEC ICARDA Project on wheat improvement
IDRC food legume improvement program
AGRIC Res. corp program
Vegetable improvement by selection and hybridation
Variety testing and improvement of chickpea and beans
Nile valley project on faba bean
Variety evaluation of various vegetable crops

119 ARC -- Wildlife Research Center (Khartoum)

Fine ecology in DNP
Botanical composition changes in DNP
Classification of plants of dinder and other wildlife areas
Fire studies
Habitat study in dinder
Survey of wildlife areas in Sudan
Forage improvement
Population study in dinder
Meat production in wildlife
Parasite survey in wildlife
Dinder national park assessment & promotion
Study of wildlife management
Study of wildlife values in the Sudan
Weed control

201 APVR -- El Huda Animal Products

Studies on product. parameters in desert sheep under irrigation environment

202 APVR -- Soba Veterinary Research Laboratory

Study of effect & irradiation of some Mycophasmail strains & trials
Pox viruses
Theileriasis in sheep
Study of fungal microflora of animal dropping and soil
Control of Brucellosis
Studies on the pathophysiology & immunology of S.boris infection
Effect of alkali plus urea phosphates
Clinico-physiological studies on molasses as substitute for grains
Physio chemical studies on blood & serum of livestock
Effect of H. blood on developmental biology of mosquito aedes egypt
Studies on Toxic Plants
Metabolic profile test as a tool for diagnosing production diseases
African horse sickness
Supervising two MSc theses
Pneumonias n domestic ruminants
Intro & trials to produce porncella abortus st. 19 vaccine
Dermatomyosis in animals
Problem of aspergillosis in livestock in Sudan
Sheep goat pox
Chief editor of the N.C.R.
Local production of anthrex vaccine
Investigation on arboviruses

INSTITUTION CODE AND NAME	DESCRIPTION OF RESEARCH PROJECTS
	Skin diseases of domestic animals
	Clinico physiological studies on molasses
	Mosquito ecology
	Control of Theilerosis
	Migration of normal and irradiated S. bovin lawal in mice
	Metabolic profile test for diagnosing production diseases
	Upgrade of P.muttocida vaccine
	Control of Bovine Mastitis
	Introduction of dost chaeveoi toxoid to immunize animals
	Mineral status in pasture
	Evaluation of insecticides in tick control
	Study of dermatomycotic infection in diff. animal species
	Studies on Mycobacteria
	Minerals & trace elements survey
	Toxicity of plants & insecticides in domestic animals in Sudan
	Tabanidea distribution
	Editor Sudan Journal of veterinary research
	Rinder pest vaccine
	Aspergillosis in animals poultry
	Dog parasites
	Rinderpest RP like dise control
	Goiter in camel
	Camel nutrition diseases
	Camel Diseases
203 APVR -- Strukaba Animal Products	
	Evaluation of grass and legume production and digestib. under irrg. condit.
	Feeding and management syst. of dairy cows
	Comparison of three systems of reaning dairy h.
	Early weaning of indigenous calves
	Species evaluation grasses and legumes
	Types of animal in Barakat area
	MSc on forage agronomy
204 APVR -- Um Benien Animal Products Research	
	Acclamatization of 2 imported legume fodders
	Application of animal manure as a fertilizer to grass fodders
301 NRC -- Economic and Social Research Council	
	Relief and rehabilitation in Sudan
	Political economy of famina
	Meat marketing
	Impact of returning migration on ec.
	Channels of distribution of important consumer goods and prices in Khartoun
	Economic crisis in Sudan
	Inflation and money supply in Sudan
	Foreign debt management and balance of payment policies
	Manpower requirements
	Channels of distribution of some main consummer products in Khartoum
	Privilization and change in the public sector

INSTITUTION
CODE AND NAME   DESCRIPTION OF RESEARCH PROJECTS

Capital accumulation
Regional and rural development

302 NRC -- Agricultural Research Council

Biological control of date palm scale insects
Survey of natural enemies of some important aphid pests
Pests & diseases of gum arabic trees
Biological control of water
Pesticides in Sudan
Animal Fascioliasis
Animal schistosomiasis

401 PI -- Abu Haraz

Descriptive study of rainfed farming and farmers in estern gezira community
Use of growth regulators with summer tomatoes
Varietal hardiness of Okra to low temperature
Mixes for nursery plants
Seed health testing

402 PI -- Abu Naamu

Response of wheat to N P fertilizers under Abu Naama conditions
Testing Abo Naama soils for P
Cutting intervals of lubia
Research
Variety trial onion & tomato
Senior lecturer
Nutritive value of forages
Fertilizer application of different vegetable crops
Cultural practices cucurbits
Naturalization of berdi and hammarya

403 PI -- Koko

Cheese
Fermented milk
Use of Enzymes in diagnosis
Milk hygiene
Study of sudanese toxic plants

404 PI -- Shambat

Improving quality in cattle
Intercropping Project
Control of soil insect (termits)
Mango flowering & fruit
True potato seed trials
Survey of seed borne diseases in Sudan
Salt problems in shambat
Biomass of Pionneer Grass from 1st, 2nd, 3rd ratooms
Bioessay of insecticides on stored grain pests (cowpea beetle)

INSTITUTION
CODE AND NAME DESCRIPTION OF RESEARCH PROJECTS

Vegetable production
Improving production efficiency in dairy cows

405 PI -- Soba

Desertification - minimizing negative effects ot it
Evaluation on sunt tree

501 UNI -- Department of Agricultural Engineering

Measurements of soil force acting on soil engaging implements
Research for the degree of MSc in Agriculturre Eng.
Computer simulation of aeration process
Drow or power & field consuption of various tillage implement
Evaluatio of Sugar Cane plants
Field loss evaluation of a combin. harvesting in rice crop
Increasing the efficiency of tillage
Improving the ridger performance in split ridging operation
Operations for certain crops in Sudan

502 UNI -- Faculty of Agriculture

Effect of insect borers on acacia spp
Mechanical harvest of sesame
Heat transfer in stored sorghum
Investigation of potato diseases
Breeding sorthum for water stress tolerance
Postharvest handling of mangoes
Viruses of Vicia faba
Response of sugarcane to NPK and micronutrients
Growth of production of sorghum under water stress
Combine losses of groundnuts
Trained manpower needs for forestry development
Development & control strategy of heliothes on food crops
Pulping some exotic & fast growing sudanes species
Cyanide levels & b-amylase in sudanese beverages
Photoperiodic response of sesame
Fertilization of sugar cane
Research reports and pamphlets
Virus diseases of vegetable
Strengthening of Agric research
Essential oils of medicinal plants
Effect of different environment & treatment on guar in Sudan
Sudan unep legume project
Studies on flowering of mango
Improvement of the post harvest handling storage & ripening fruits & veget.
Conference paper
Administration in Sudan
Tannins in grasses
Complex utilization of sudanese guar trials
Icarda nile valley project
Stability & characteristics of anthocyanins in roselle (Karkadeli)
Propagation problems

INSTITUTION CODE AND NAME	DESCRIPTION OF RESEARCH PROJECTS
	Germ plasm collecting for sorghum & sesam
	Post harvest grain loss assessment & reduction
	Sporables irrigation for off season prod. of Toualoc
	Impact of intensive use of Agri. machinery on soil productivity
	Plant parasitic mates
	Seed Pathology
	Economics of crop prod. in N proving
	Water pollution
	American Bollworm project
	Weed control in general PhD topic
	Variety selection in sugarcane
	Utilization of cutting method to propagate ornamental plants
	Agric cooperative in Sudan
	Anatomy of Sudan forest service
	Biomass of important sp in Sudan
	Effects of stages of development of mango seeds on germination
	Growth and production of some introduced pasturre spp
	Dairy microbiology
	Evaluation of ABS experiment credit for small farmers
	Response of forage legumes and grasses to fertilization & plant population
	Citrus gummosis in the Sudan
	Costing forestry operations
	Tools for management of Sudan natural forests
	Effects of fertilizer materials on fruit quality & yield of vanana plant
	Drinking water in the united arab emirates (fluorides & bromides)
	Deriving 2 papers from the PhD thesis
	Estimation marketing costs of margins
	Impact of continuous devaluation on crop
	Ethanol from molases
	National beekeeping project
	Weed control in lucerne
	Virus diseases of legumes
	Mass transfer in stored sorthum
	Control of whitefly
	Breeding sesame for water stress tolerance
	Improvement of fruit production
	Viruses of wheat
	Studies on the storage of groundnut seed
	Reclamation of saline-sodic soils
	Food chemistry
	Journal articles
	Modelling of gezira and rahad schemes
	Agricultural credit in Sudan
	Studies on effects of tillage on crop yields
	Study of OYDV and its effect on onion production in the Sudan
	Alilatoxin level in sudanese food and feedstuffa
	Effect of different drying methods on rice quality
	Seed pathology of wheat and sorghum
	Improvement of citrus production
	Cholesterol content of sudanese foods
	Research in Ama of food and nutrition
	Construction of a yield table to the tree species eucalyptus
	Effect of browning enzymes on keeping qualities of processed foods

INSTITUTION
CODE AND NAME   DESCRIPTION OF RESEARCH PROJECTS

Polyphenoloxidases in x-potatoes & sweet potatoes
Stored products pest control
Evaluation of nursery stocks
Fertilization of vegetable crops
Natural and solar energy drying of groundnuts
Pereoxidases in x-potatoes and sweet potatoes
Grass croppers research
Evaluation of house plants
breeding high yielding sesame
Grain storage research
Forage crop harvesting
Resistance of post harvest cereals to stose product insects
Effect of irrigation frequency and water ...... in production of .....
Study on pump irrigation in Khartoum province
I.M.P.North Carolina
Performance of venz. sorghum intrants in Sudan
Effects of decortication of mango seeds on germination and polyembryony
Pulping potentialities of leudaena and conocarpus
National grain legume project
Response of chickpea to inoculations of ferti.
Breeding Sniga Resist sorghum cultivars
Community forestry development
Seed research
Essential oils of fruits
Quality aspects of food crops
Annual reports
Small farmer agric. credit
medicinal and aromatic plants
Complex utiliz. of giomases from latex-bearing species
Date palm scale project
Mineral nutrition of banana plants
Effect of chem.&phys.wood properties & charcoal on quality & yield
Effects of x-ray ivrad on sorghum
Evaluation of surface irrigation practice in Sudan
Plant parasitic nematodes
Vegetative propagation of guava plant
Nutritional problems of cotton in Gezira
Biology & ecology of some important field crop pests
Yield determination of plantations
Volume table for Eucalyptus sp
Water requirements of selected crops
Production of mudaffara cheese from different sources of milk
Use of Plant hormones in propagation
Pit viz warehouses storage of cereal grains
Herbicid application methods

503 UNI -- Faculty of Veterinary Science

Study of fascioliasis in sheep
Clostridum sordellii
Age & maturity of reproductive efficiency in cross male & female calves
Ca....... metabolism in camels
Brucellosis of wildlife

INSTITUTION CODE AND NAME	DESCRIPTION OF RESEARCH PROJECTS

Structure of the casctid simis of the goat
Fluke immunity
Clestridia of Camel
Sheep pox
Reproduction in male camel
Post partum Reproductive efficiency
Study of the poll gland of camel
Ultrastructure of casetid skins & body of the camel
Use of antistress drugs in animal
Alhali treated agric. byproducts
Effect of season & gondotrophin releasing hormone on pubrty in sheeps/goats
Effect of season & sonadotrofins on testis function in camels
The pro.....
Cattle improvement
Salivary glands in the camel
Minerals in .... livestock pasture/soil & effect toxic plants to ruminan
Semen freezability & thawabily in F1 & F2 male calves of reprod. efficiency
Bovine brucellosis
Blue tongue
Studies on gumboro
Endocrine physiology
Water metabolism
Medicinal plants
Field study on biological control of schisto somiasis
Trace elements deficiency
Camel ecology
Study of endocrine glands of camel
Ultrastructure of camel intestines
Research for M.V.sc.
Schistosomiasis control
Johne's disease diagnosis
Immunohistochemistry of the camel intestine
Sheep Abscess syndrome
Damage and repair of cells
Studies on nabes
Antibiotics
Thermoregulation in mammals
Camel Metobolism of Drugs
Nutritional physiology
Reproduction in other animals & endoginology
Onchocerciasis using Nile rats as human models
Lamb mortality in sheep farms
Lipid metabolism in camels
Progrm with A.I. new system
Skin glands in the camel
Salmonellosis in Sudan
Peptide hormones in the digestive tract of the camel
Gastro intestinal nematodes of ruminants in the Sudan
Survey on gastro intestinal parasite of camels in Sudan
Toxoplasmosis
Bacteriology of processed food
Ruminants physiology of digestion
Ecology of fresh water snails

INSTITUTION
CODE AND NAME   DESCRIPTION OF RESEARCH PROJECTS

Studies on effect of melanom & Squmus ce carcinom in goats
Bacterial vaccines for poultry
Meat hygiene and microbiology
Diseases affecting the quality of the
Post partum interine infection way of treatment
Epidemiology of animal boncellosis
Effect on stress on testis function in donkeys
Bee Honey Medicinal Uses
Drug metabolism in the animal in Sudan
Reproduction in camels
Effect of mstities on the quality of milk
Environmental physiology
Camel reproduction

504 UNI -- Institute of Animal Production

Influence of level of supplementation on dairy cow
Effect of treatments on nutritive value of agro byproducts
Growth performing briders
Proteins to process meat
Influence of season on milk progresterone
Study of camel sausages
Comparative study on production and reproduction traits of local goats
Lam production
Effect of chemical and physical dreadment on feeding value of sugar cane
Determination of feeding value of sorthum grain varieties
Study of blending vegetable
Effect of level of nut. on pituitary function
Utilization of agro-industrial by-products
Effect of season physiological status on milk yield
Agricultural by-product project
Characteristics of sheep
Evaluation of camel meat

505 UNI -- University of Gezira

Blossom & rot of watermelon at the heavy clay soils of Crezira
Assessment of tenancy size and economic performance study in Sudan
Digestibility of alkali-beated groundnut
NPK fertilizers on tomato
Ecology & biology of blepharis sp.
Potato growth & yield
Wheat production in Gezira area
Vegetation of water courses in Sahara
Dairy production systems
natural products as pesticides
Nutritive value of soybeans
Tomato diseases
Protein requirements of chicks
Grwoth & development of eucalyptus
Summer tomato production
Physiology of production of fruit tree crops
Sugarcan yield & quality major advisor in response of agronomic practices

INSTITUTION CODE AND NAME	DESCRIPTION OF RESEARCH PROJECTS
	Powdery mildews on tomato
	Post-graduate (MS & PhD)
	Diseases of off-season tomato
	Studies on germination & emergence problem of sweet pepper seeds
	Sugar can diseases
	Seed rate
	Inoculation of phasoleas
	Blossom & rot in watermelons
	Wheat seed storage as affected by chemical dressings
	Studies on spliting & early bolting char. some sudanese onion cultiv.
	Nutritive value of sorghum by prod.
	Studies on the survival & race differentiation of X.malvacearm
	Introduction of jojoba into the irrigated schemes (Gezira, Rahad)
	Physical charact. of local eggs
	Nutritive value of exogeneous grasses
	Screening of pesticides
	Milk production system of the Gezira farmers
	Economic & social development strategy for central region Sudan
	Tracta repair & maintenance
	S. status in Rahad & response to S fert.
	Appraisal of agricult. production relations under joint indiv. account syst
	Tillage systems for Rahad scheme
	Production systems for groundnuts
	Inoculation & fertilization of soybean
	Resistance of insects to insecticide
	Evaluation of productive characteristics of Sudan breeds of sheep
	Vegetable production seed production
	Heatstress in dairy cattle
	Water management program
	Wilt & rot diseases of fababeans
	Alternative methods for the control of cotton white fly
	Investigations into blossom & rot of cucurbits
	Effect of seed rate on wheat products
	Sorthum pathology
	Utilization of poultry by-products
	Biomass production by mosquios
	Effect of NPK on onion seed production
	Improvement of food legumes with special emphasis on drought resistance
	Influence of Nitrogen fertilization on sesame growth yield & seed quality
	Insecticide residues
	Studies on sugarcane smut
	Evaluation of imported potato cultivars under gezira condition
	Pesticides storage & formulation
	Weeds & weed control
	Energy resource in central region

SUDAN ATMS Human Resources Inventory

Table 5: List of Desired Training by Institute
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01/30/88
Page 1

INSTITUTION
CODE AND NAME DESIRED TRAINING
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101 ARC -- Abu Naamu Research Station

- Use of mutation in improving certain qualities in sorthum
  Striga resistance (not availale in Sudan)
- PhD training (long term)
  Short duration courses in agronomy and related disciplines (eg striga control, cropping system, soil moisture, conservation, etc.)
  Dry land farming
- Research management and work experience in other countries
- Long term training to get more knowledge about career (not available Sudan)
- Master in agricultural extension and socio economics (long term not availa ble in Sudan)
  Short courses in communications and audiovisuel
- Long term training on mutation breeding tech.
  Short term training visits or courses in diff. coutries sesame developing projects.
- P.Hd. (long term not available in Sudan)
- Fertility management of vertisols of central clay plaines Sudan (long term not available in Sudan)
  Advanced methodology of research on Nitrogen management & transformations in vertisols for max efficiency (long term not available in Sudan)
- Systematic identification of pathogenic diseases of different tropical crops, vegetables & fruit trees. (short term)
  Utilization of Sudan organic waste for biocontrol of seed & soil borne diseases (long term)
  Biological control of aerial diseases (long term)
- Traiing in determination of residues in plants and soil using HPLC, GLC and hother instruments (Not available in Sudan)

102 ARC -- Fisheries Research Station (Port Sudan)

- PhD degree in aquaculture economics
- Using of coastal oceanography equipments
  Computer programminh
- Visits to oyster culturre abroad
  Computer programming
  Use of equipment for measurement of oceanography paramet.
- PhD in shrimp biology, barming, techniques

103 ARC -- Fisheries Research Station (Shigara)

- PhD degree in productivity
  Short term orientation visits to various countries where capture fishery & aquaculture practices are advanced
-

INSTITUTION
CODE AND NAME DESIRED TRAINING

- Short term training on techniques used to measure & evaluate pollutants in marine and fresh water ecosystems (this type of training is not available in the country)
- Computer science & system analysis
  Radioisotopes uses in tracing fish physiology & ecology
  Genetics, for chromosand mapping for phylogeny of fishes
- PhD degree in the field of ecology chemotaxation of fishes (not available in Sudan)
- Short-term orientation visits to advanced countires in agriculture.

104 ARC -- Food Processing Research Center

- Project evaluation in economic development (long term International Bank Washington
- Short courses in field of oils and fats and fatty foods
- On theoretical & practical aspects of food drying (eg solar drying)
  On packing requirements for dry foods
-
- Training in processing and technology of fat and oils
- Molecular biology (short training not available in Sudan)
- Short term training in field of leadership in food systems
  New and update research planning and analysis
- On programming for small scale industries short term (not available Sudan) On stability of natural beverages (not available in Sudan)
  On types of quality of packaging materials (not available in Sudan)
- Attend conferences and seminar
- Short term courses and visits to international laboratories (not available in Sudan)
- Carbonated beverages
  Texture of processed foods
  Baby foods
  Quick cooking beans
- Laboratory analytical & rheological equipment maintenance & uses in cerealsComputer data analysis in project development
- Short term course in gas chromatography GLC
-
- In factories producing fodder yeast, bakker yeast, bio-ethanol, biogas
- In food irradiation
- PhD in nutrition
- Research management (short term, not available in Sudan)
- In the field of cold storage of fruits and vegetables. Visit to huge cold storage (not available in Sudan)
- To attend conferences and courses in advanced technology
- On using some new equipment and techniques in microbiology (short term, in advanced countries)

105 ARC -- Forestry Research Station (Soba)

- On systematic forest botany and hebarium techniques
- PhD degree vegetative propagation of acacia senegal via tissue culture (long term training not available in Sudan)

INSTITUTION
CODE AND NAME DESIRED TRAINING

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- On plant parts and tissue culturre in propagation of forest trees (long term training - PhD degree)
  Short term training (short courses not available in Sudan)
- Social forestry as an important technique in forest research.
- In research planning and management
- Silviculturr and management tree species (long term)
  Nursery techniques and management practices short term training
- In the field of Animal nutrition (long term)
- For tree improvement programs needs training in breeding methods and tissueculture techniques (laboratory training) of short-term (not available in Sudan)
  PhD degree in tree physiology or genetics and breeding
- Wood anatomy and making sections chemical analysis of wood & gums resin cur(Training not available in Sudan)
- On germination treatments, seed characteristics - handling - storage
  PhD degree
  Short coursesg

106 ARC -- Gezira Research Station

- MSc and PhD degrees
- On research administration and systems of coordination of res. programs
- In Management of agricultural research
- dentification of bacterial plant pethogens using serologial techniques
- Long term training
- On isolation, purification characterization techniques in natural products chemistry
- Short visits to institutions working on soil borne diseases and fusarium wilt of cotton
- PhD degree (long term)
- In taxonomy of chrysopidae and coniopterygidae
  " " " " chalcidoidea
  " " " " Staphylinidae and coccinellidae
- MSc / Phd in agronomy and physiology of legumes
- On organization of variety testing programs and varieting release procedures at national level
-
- Dosage - montality studies testing techniques of insects
- On breeding techniques for drought
  On methods of assessment of grain quality
  Visits to international and national programs in other countries
-
- Short term visits to research station in field of insect and disease resistance
- In biological control of insect pests for short term duration
- On planning, programming and evaluation
  Biological nitrogen fixation activities in soils and plants
  Application to farming systems
- PhD training silviculturre
- Long training in plant virology
- In research management
  Transfer of improved production technology to farmers fields

INSTITUTION
CODE AND NAME DESIRED TRAINING

- Data processing and computer programming for geographical soil information
- PhD degree
- Long term training in agric engineering
- Biological studies on aquatic weeds
  Techniques of aquatic weed control (mechanical biological and chemical)
  Studies on residual effects of hebicides on water sediments
  Effects of treated water on rotational crops
- Short visit to research institutes and universities
- MSc and PhD
- Computer programming and orientation to research problems(resource allocation physical human material
  Management of irrigation water, fertilizers insecticides
- MSc / PhD degree
- (short term training) in fungi identification
- Short training course on physiology and potato production
- MSc / PhD degree
- MSc / PhD degree in plant pathology
- Evaluation of the newly introduced forage germplasm
- Short term visits to similarly interested res. institutes
- Long term training in agric engineering work
- Short term training in research management
- Long term training on pesticide residue analysis for more effective contribution in research program
- MsC - PhD degree in Soil chemistry and plant nutrition (long term)
- PhD degree
- MSc or PhD degree
- Short term training on modern analytical techniques in pesticide studies
- Research administration
- MSc / PhD degree
- On nitrogen uptake and metabolisme in higher plants
  Effect of agro chemicals in normal process of nitrogen metabolism
- Long course on pesticide residuses
- MSc or PhD on Field Water management / crop water relations
- On General fibre technology
- Short visit in research cenres and universities
- MSc / PhD stress physiology of crops under dry condition
- Tracing element eg 15 N isotopes
  Pesticides degradation by microorganismes
  Mycorrhizal association techniques
- Long term training in agric. engineering
- PhD degree (long term, not available in Sudan)
- Research management training (short term)
- Short training courses in international centers
  Scientific conferences
  Joint projects with concerned res. stations & universities
- MSc/PhD degree in agronomy & physology of field crops
-
-
- On research management and administration (short term)
- Way on use of irriadiation on male sterility
-

INSTITUTION
CODE AND NAME DESIRED TRAINING

------------- ---

- In tropical and subtropical fruit culture
  Practical training in establishing and handling citrus virus
  Short training in micronutrients
- On plant growth models using computer programs
- Computer programming
- On new technology in pest management using biological tools of resistant varieties (long term training, not available in Sudan)

107 ARC -- Guneid Research Sub-Station

- Long term training on recent agro-techniques
- traning in sugarcane research
- In recent techniques of fertilizer use and plant nutrient analysis
- Visit sugar cane breeding stations for latest means of research administration and scientific developments in cane
- PhD degree in mechanization

108 ARC -- Hudeiba Research Station

-
- PhD degree
  Training in genetic eng. techn.
  Training in tissues culturre breeding techn.
- In Potato production and storage
  In techn. of vegetable seed production
  In lentils processing and production
  (not available in Sudan)
- On stress physiology.
  Short courses or visits to institutions
- In sterile male release techniques & use of radioisotopes to control pests (short term training)
  On identification and manipulation of pests of date palms (short term)
- Water management (short training not available in Sudan)

109 ARC -- Kadugli Research Station

- Short training in plant physiology
- PhD degre (long term training not available in Sudan)
  Short term training on how to use microcomputers
- PhD in animal sciences.
- Long term training PhD degree
- PhD degree (long term)
-
- PhD (long term training in Sudan)
  Agr. course in farming system
- Long term training towards a PhD (available in the country but cross cultural experience is of utmost importance), need to have training abroad.

110 ARC -- Kassala Research Station

- Irrigation techniques of water conservation in crop production
  Greenhouse vegetable production

INSTITUTION
CODE AND NAME DESIRED TRAINING

111 ARC -- Matug Research Station

- PhD degree in mechanization

112 ARC -- New Halfa Research Station

- Short training course on plant propegation techniques, water soil analysis
- Short course on groundnut production technology
  Short course on cotton production and managemet
  Short course in wheat production
  Short course in production of faba beans
  Short course in production of sorghum
- Short training course on herbicide residue analysis (not available in Sudan)
- Short term training in biological control of wildlife
- Short term training and visits to research centers on techn. methods and equipments in plant disease research
- Visits with international research centers

113 ARC -- Obeid Research Station

- Ph D degree
  Visit to ICRISAT groundnut program
- PhD degree
- Drought tolerance and breeding for drought tolerance (short term not available in Sudan)
- PhD degree (long term)
  Short term training
- Short training in tussure culture techniques for raising acacia senegal
- Use of botanical pesticides
  Insect identification
  Estimation of crop losses due to insect pests
  Insect mass rearing
-
- PhD in soil physics
- Usage of radisisotope in agriuclturre
  Short term training
- Long term training for PhD in range science
- Short training in production economics and farm management not available in Sudan.
- On vegetable seed production potato and onion (short term courses)
  Short term training on tropical fruit production

114 ARC -- Rahad Research Station

- Training on field crops insect resistance
  Radioisotope in male sterility technique
- Visits to international research centers
  Training in foreign universities
  Collaboration with other scientists in similar international research centers

INSTITUTION
CODE AND NAME DESIRED TRAINING

- Post doctorate fellowhsip in research concerned with tillage or design of farm machinery and tools (not available in Sudan)
- PhD degree
  Short visits to international research centers
  Short training on administration
- Different techniques of measuring water requiiiements for plants and soils

115 ARC -- Sennar Research Station

- Training long term in mutation breeding
- Most recent progresses in the field of agricultural entomological research with reference to the ecological approach of insect pest control. Training of short term nature (not available in Sudan)
- Long term training (1-2 years)in area of crop nutrition &irrigation regimes in well-equiped research institutions
- Long term course in field crops

116 ARC -- Shambat Research Station

- Sabatical leave to tropical stoned products institute (UK and Indian Grain Storage institutes to be acquainted with the principles of chemical controlChemical control (neem etc.)
  Short course not available in Sudan
- Sabbatical leave in West Germany to get acquainted with recent methodology in using the neem for the control of insect pests
- On biology and control of parasitic weeds (Triga SP & Orobanche spp)
- Visits to internatioal research centers like AVRDC in Taiwan and CIP in Peru.
- Visit to International Potato Centre (Peru) (sabbatical leave) for relksech involving manipulation of cultural practices for optimum improvement of quality potato yield.
- short visits to specific research centres

117 ARC -- Shendi Research Station

- Short course training on wheat physiology (CIMMYT)
- Advanced courses in plant breeding
  Avanced methods in plant breading techniques
  (long term training, not available in Sudan)

118 ARC -- West Sudan Research Headquarters

- Identification of research need planning of research and establishment of priorities within staff and budget restrictions. (short term training,not available in Sudan)

119 ARC -- Wildlife Research Center (Khartoum)

- Short courses in computer, simulation and modeling (not available in Sudan)
- In the field of wildlife census, remote sensing, and environmental education (short term training and visits to diff. countries

INSTITUTION
CODE AND NAME DESIRED TRAINING

- PhD degree (long term not available in Sudan)
-
-
- Short term training in wildlife, not available in Sudan
-
-

201 APVR -- El Huda Animal Products

- Training course sheep production systems development (not available in Sudan)

202 APVR -- Soba Veterinary Research Laboratory

- Short training courses in mycotoxicologial methods of isolation, purification and identification
-
- Short training in modern diagnostic virology or viral vaccines
- Training in advanced techniques in parasitology and immunology (short training courses)
- Virology latest techniques
- Short visits to various laboratories
  Training in electro microscopy transmission and scanning
-
- In using radioisotope technique (short term training)
  Data processing (micro computer) (short term)
- On large scale production of highly promoted types of vaccines
  Course in immunization
- On most recent discoveries and publications short training not available in Sudan
- Long term training course i epidemiology of animal diseases (not available in Sudan)
- The use of ELISA technique for the diagnosis of theileriosis and other diseases is required for a short period of 3 months. Not available within the country at the moment.

203 APVR -- Strukaba Animal Products

-
- PhD degree
- On Animal production with emphasis on Forage utilization

204 APVR -- Um Benien Animal Products Research

- Advanced research in range science and animal nutrition. (long term)

301 NRC -- Economic and Social Research Council

- PhD degree in economic (long term not available in Sudan)
-
- Short courses visits and contacts with other research institutions
- PhD (not available in Sudan)
- PhD degree (long term not available in Sudan)

INSTITUTION
CODE AND NAME DESIRED TRAINING

- Short term training courses

302 NRC -- Agricultural Research Council

- Short term training on mono donal antibody technology (not available in Sudan)
- In coordination and management of research activities abroad
- Short training course on analysis and identification of residues of pesticides (not available in Sudan)
  Long term training in breeding of new entomophages and quarantine of IPM programs

401 PI -- Abu Haraz

- Short term courses
  Long term courses PhD degree (it is potentially available within the country)
- In short nature 2-4 weeks in British mycological institute (not available in Sudan)
- PhD degree in agricultural extension studies
- Short term naturre "visits"
- PhD degree
  Short training in welding, Lathe works
- PhD degree
- PhD degree (not available in Sudan)
- Plant protection
  MsC degree to be lecturer
  Short course to keep up to date in the techniques of specialization
- The type of job needs teaching and research to achieve career objectives
  PhD degree course

402 PI -- Abu Naamu

- Long term training 1- tissue culturre, 2- vegetable breeding, 3-medicinal plants
- PhD in medical of veterinary entomology
  Courses in reming insects
  Courses in instrumentation of lab techniques
- PhD in soil and plant analysis
- Higher education institutes administration
- In range management
- In the field of water stress of perennial cereal fodder

403 PI -- Koko

- Short courses in poultry production
- To carry post-docterate research to follow the latest research facilities abroad.
- PhD study program on meat science (not available in the country 3 years)
-
- Control of poultry diseases
  Isolation & identification of avian pathogene
-

INSTITUTION
CODE AND NAME DESIRED TRAINING

- Dairy goat husbandary
  Goat control to reduce the destruction of the goat to vegetation
  Dairy goat production (short term in e.g. Egypte)
- Long term: PhD degree
  Short term: refresher courses (available)
- Short courses in rural sociology
- PhD degree course in parasitology (3-4 years)

404 PI -- Shambat

- In computer use for ration formulation
- Short training in computer
- Long term training Ph D degree in entomology
- PhD degree in agricultural engineering (long term training)
- Short course in horticulture
  Short course in Agric Education
  Short course in research management
- In water relation aspects (eg. stress physiology)
  In data analysis and computer processing (both not available in Sudan)
- Training on pest management and surveys, short training not available in Sudan.
- Short training in teaching
- In soil reclamation and mineralogy
  In computer and data analysis
- PhD degree in agronomy
- Effect of mechanical Pruning on ware potato production from true seed
  Effect detuberization on flowering & berry & seed production of potato in Khartoun area
- In recent techniques in embryo transfer in cattle and sheet (short term)
- PhD degree (long term)
  Short courses on machinery operation, servicing engine maintenance
- Short courses in horticulture
- PhD degree (long term)
  Short term training courses and seminar

405 PI -- Soba

- Short visits and courses to countries dealing with desertification
- Short courses on teaching methodology
  Long term courses on forest management
- PhD degree
- Plant soil relationships using chemical analysis (not available in Sudan)
- Study of foresty economics
- PhD degree in plant taxonomy (not available in Sudan)
-
- Short term course on forestry extension

501 UNI -- Department of Agricultural Engineering

- PhD degree
- MSc degree course (long term training, not available in the country
- Design & manufacturing processes of soil engaging implements, power units & system engineering methods (not available in the country)

INSTITUTION
CODE AND NAME DESIRED TRAINING

-
- Design & selection of agricultural machinery (long term training outside Sudan)

502 UNI -- Faculty of Agriculture

- In preparaton of project proposals related to agricultural
  In virus free budwood certification projects
-
- Statistical procedures & expt design (short term not available in Sudan)
  Tissue analysis (short term not available in Sudan)
  Computer programming (Short term not available in Sudan)
-
- Forest survey techniques and methods
  Forest yield science
- Visits to agric. colleges in food science and human nitrition
- In advanced irrigation science and technology
- Post doctorate in seed sciences
- Training in genetic engineering of bacteria
- Short term training in micro computer
- Short term training in relevant institute
-
- on computer
-
- Teaching methods of new development techniques in silviculture, agroforestry and forest soils
  Design and analysis of agroforesty experiments
  Project planning and execution
- In forest insect pests
  In biological nitrogen fixation
- In advanced biometry and computer science (short term training)
- Spectroscopy and gas chromatography
- Short term training in forest management (not available in Sudan)
- On food preservation (use of irradiation in food technology)
-
- Statistical techniques including computer programming related to analysis of entomological data
-
- PhD degree in forest economics
- On methods and techniques of education
-
- Computer analysis (short courses)
- training in biometrics (short term: 6-9 months not available in Suday)
- PhD degree in agronomy
- PhD degree in pesticides
- On modern techniques of pesticide application and pest control in general
-
-
-
-
- On lecturing
  On extension
  On seminars

INSTITUTION
CODE AND NAME DESIRED TRAINING

- In nitrogen fixation technology (1 year)
- Short visits to become acquainted and make use of newer methods & technique(short term, abroad)
- Short term training courses to study the new techniques & advances in the area of pomology (fruit crops) (not available in Sudan)
-
- Short visits for data processing
-
- Short term courses on water relations of plants
- Long term training in recent developments in agronomy
  Visits to international research centers
-
- Short courses abroad
- Taxonomical statiscs in the field of nematology
- Short visits to institutes & organizations abroad
  Academic links between universities
- Need further training
- Visiting labs in other countries to be acquainted with the latest acquainted with the latest technology in the area of postharvest physiologywould be of great help.
- Training abroad where potentialities & equipments are available
-
- Training required in field of development planning techniques, economiics, econommetrics, moder research methodology and computer programming & use. (medium term not available in Sudan)
- Training to conduct culture studies will be of value. This for estimating the critical nutrient levels and the approximate plant needs. The study of short-term period is not available in the country.
- Modern techniques in the study and diagnosis of plant viruses e.g. ELISA - EM - electrophoresis, etc.(9-12 months, not available in Sudan)
-

503 UNI -- Faculty of Veterinary Science

-
-
- Short training on preparation of vaccines against blood protoroa
- Audio visual aids to teach methodology salient computor programming
- Training program for higher degree in field of physiology
- Training on advanced current methodology (for short intervals)
- Training in immunohistochemistry (short term nature, not available in Sudan
- 1-2 months to be spent abroad for library consultation and data analysis.
- Short training to masyer techniques to measurre sonadotrohin relasing horme receptors in the pituitary and assau for measurement of melatonin concentration (short training not available in Sudan)
- Short term training in morphomeny, immunohistochemistry, and freeze fracturing techniques and autoradiography
- Management of intensive sheep farms in tropical countries (not available in Sudan)
-
- Radioisotope Research Techniques

INSTITUTION
CODE AND NAME DESIRED TRAINING

- In using of radioachire isotopes in animal reproduction short term nature (not available in Sudan)
- In recent methods of immunology specially nuclear techniques and biology (not available in Sudan)
- Use of tracer techniques in animal physiology
-
-
- Training program for higher degree PhD program
- Modern methods in the diagnosis of injection diseases besides the recent techniques used to choose the best treatment & control (short courses in one of the advanced countries)
- Computer analyses
-
- In application of computer in animal health problem
- Short term immunobiology (currently not available in Sudan)
- Modern techniques in biomedical science e.g. reproductive biology (short term training, not available in Sudan)
- Training in state of the art method in pharmocology & biochemistry & toxicology (not available in Sudan)
- Training & research to PhD level in field of anatomy (not available in Sudan)
- Short term training of 3-6 months (not available in Sudan) Redax potential and growth of Clostridie
- Short course, RIA in reproduction (radio immuno assy)
-
-
- Visits to universities and research institutions in other countries
-
- Specialization on PhD level in nematology (not available in Sudan)

504 UNI -- Institute of Animal Production

- In technique of radio immuno assay (short training
-
- PhD degree (long term not available in Sudan)
-
-
- Joint research in collaboration with other universities. Seminars and conferences
- Training in advanced methods of nutrition laboratories (not available in Sudan)
-
-
- PhD degree (long term)
-

505 UNI -- University of Gezira

- Post-doctoral research training to update research knowledge and skills (1-2 years, not available in Sudan)
- Use of the most recent & advanced techniques in evaluation of seed quality in different agronomic & vegetable crops seeds (short training abt 9 months, not available in Sudan)

INSTITUTION
CODE AND NAME DESIRED TRAINING

-
- Work in radioimmunoassay for hormone measurement
- Research administration
  Training for various level specializations
  Extension & evaluation of curricula & curriculum development
  (none available in Sudan)
-
- Advances in nitrogen fixation. (training available at UCD, USM)
- Training in agrometeorology & instrumentation (not available in Sudan)
- Training requiied in animal & poultry feed technology
  Training in extension
  (both short term nature, not available in Sudan)
- Post-graduate studies for M.Sc and PhD (long term nature not available in Sudan)
- Visit abroad universities and research centers to update knowledge and do some joint research projects (short term period 3-6 months)
- On-farm research, i.e. farming system research methods, means & appraisal of experiments
  Curriculum development in University Teaching
-
- Training in new techniques for detection of viruses in seeds e.g. ELISA & ISEM
  Evaluation of programs in University Teaching
  (Short term, not available in Sudan)
- Training in inoculum production and quality control of rhizobial inoculants(not available in Sudan)
- Tissue culture use in crop improvement
  Mutation breeding
- PhD degree research program (long term nature)
- Research on bioche. and physol. of insectivide potentiation phenomena
  Training in insecticide chemistry and formulation (short term 6-12 month, not available in Sudan)
-
- Post-graduate training for a PhD (long term not available in Sudan)
- Update knowledge in the fields of economics and agric economics (short term - symposiums, seminars, etc.)
-
- General area of multipurpose production systems particularly tropical rangelands
  Special interest is techniques & economics of agroforestry (silvopasture)
  Land use strategy & planning
  Biomass production and utilization
  (none available in Sudan)

Table 6: Number of Researchers in Educational Discipline Categories by Institution

02/01/88
Page 1

INSTITUTION CODE	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	TOTAL NUMBER RESEARCHERS
	----- Number of Researchers in each Educational Discipline Category ------													
100 ARC -- Agricultural Research Corporation														
101	1	0	0	0	5	2	1	0	0	0	0	1	0	10
102	0	0	0	0	0	0	0	0	0	0	0	4	0	4
103	0	0	0	0	0	0	0	0	2	4	0	0	0	6
104	1	0	0	1	4	0	0	0	0	0	0	0	15	21
105	0	0	0	0	3	0	0	4	1	0	0	2	0	10
106	2	0	0	6	28	12	6	1	1	0	3	6	0	65
107	0	0	0	0	1	2	0	0	0	0	1	1	0	5
108	0	0	0	0	4	0	1	0	0	0	0	1	0	6
109	0	0	0	3	1	0	0	0	2	0	0	2	0	8
110	0	0	0	0	1	0	0	0	0	0	0	0	0	1
111	0	0	0	0	0	0	0	0	0	0	1	0	0	1
112	0	0	0	0	3	2	1	0	0	0	0	0	0	6
113	0	0	0	2	4	0	1	1	1	0	0	3	0	12
114	0	0	0	0	2	1	1	0	0	0	1	0	0	5
115	0	0	0	0	3	0	1	0	0	0	0	0	0	4
116	0	0	0	0	3	1	2	0	0	0	0	0	0	6
117	0	0	0	0	2	0	0	0	0	0	0	0	0	2
118	0	0	0	0	1	0	0	0	0	0	0	0	0	1
119	0	0	0	0	1	0	0	0	1	0	0	6	0	8
	4	0	0	12	66	20	14	6	8	4	6	26	15	181
200 APVR - Animal Production and Vet Research														
201	0	0	0	0	0	0	0	0	1	0	0	0	0	1
202	0	0	0	0	0	0	0	0	12	0	0	0	0	12
203	1	0	0	0	0	0	0	0	2	0	0	0	0	3
204	0	0	0	0	0	0	0	0	1	0	0	0	0	1
	1	0	0	0	0	0	0	0	16	0	0	0	0	17
300 NRC -- National Research Council														
301	2	0	0	4	0	0	0	0	0	0	0	0	0	6
302	0	0	0	0	0	2	0	0	1	0	0	0	0	3
	2	0	0	4	0	2	0	0	1	0	0	0	0	9
400 PI -- Polytechnic Institute														
401	1	1	0	0	1	3	0	0	1	0	1	1	0	9
402	0	0	0	0	3	0	1	0	0	0	0	2	0	6
403	0	1	0	1	0	0	0	0	8	0	0	0	0	10
404	0	0	0	1	4	2	2	0	2	0	3	1	0	15
405	0	0	0	0	0	0	0	5	0	0	0	3	0	8
	1	2	0	2	8	5	3	5	11	0	4	7	0	48

INSTITUTION CODE	----- Number of Researchers in each Educational Discipline Category ------													TOTAL NUMBER RESEARCHERS
	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	
500 UNI -- Universities														
501	1	0	0	0	0	0	0	0	0	0	4	0	0	5
502	2	0	0	4	15	7	2	7	2	0	6	5	6	56
503	0	0	0	0	0	0	0	0	34	0	0	0	0	34
504	0	0	0	0	0	0	0	0	11	0	0	0	0	11
505	0	0	0	1	5	4	1	0	3	0	5	4	0	23
	3	0	0	5	20	11	3	7	50	0	15	9	6	129

SUDAN ATMS Human Resources Inventory

Table 7: Summary of Professional Indicators by Institute

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Page 1

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
101 ARC -- Abu Naamu Research Station				
	8	1	3	1
	8	3	3	4
	13	1	2	5
	0	0	0	2
	1	0	0	1
	0	0	0	0
	0	0	0	0
	0	2	0	0
	1	3	1	0
	5	1	0	0
Averages:	3	1	0	1
Number of Researchers: 10				
102 ARC -- Fisheries Research Station (Port Sudan)				
	10	1	3	2
	2	0	1	1
	1	1	1	0
	9	3	1	3
Averages:	5	1	1	1
Number of Researchers: 4				
103 ARC -- Fisheries Research Station (Shigara)				
	1	5	4	3
	0	0	2	0
	5	0	0	0
	7	2	3	1
	0	0	0	0
	32	8	1	41
Averages:	7	2	1	7
Number of Researchers: 6				
104 ARC -- Food Processing Research Center				
	3	3	3	0
	0	0	0	0
	2	2	0	3

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
	2	0	0	1
	1	0	0	0
	13	6	4	1
	20	3	0	3
	1	1	2	0
	4	2	0	1
	8	2	0	0
	2	1	0	2
	2	1	1	5
	4	2	0	0
	1	1	0	1
	2	0	0	1
	21	6	1	3
	3	1	0	1
	48	3	1	26
	6	2	0	6
	3	0	0	1
	14	6	0	1
Averages:	7	2	0	2

Number of Researchers: 21

105 ARC -- Forestry Research Station (Soba)

	0	2	0	0
	1	2	0	2
	2	0	0	0
	0	0	0	0
	10	5	0	5
	0	0	0	4
	7	3	0	5
	1	0	0	1
	2	0	0	0
	4	0	0	0
Averages:	2	1	0	1

Number of Researchers: 10

106 ARC -- Gezira Research Station

	0	1	0	3
	21	3	6	7
	29	1	0	5
	30	0	4	7
	0	0	0	0
	24	2	4	2
	13	1	5	2
	3	0	0	2
	4	1	0	3
	0	1	0	0
	17	3	1	2

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
	32	2	3	5
	0	0	0	0
	5	4	30	10
	4	1	1	6
	5	2	2	0
	4	1	0	2
	30	4	3	4
	4	5	0	1
	0	1	0	2
	24	0	0	4
	4	3	0	6
	0	0	0	0
	0	1	1	0
	0	0	0	0
	6	0	0	2
	0	1	0	1
	23	2	0	6
	0	1	0	0
	4	0	0	0
	15	2	1	2
	0	1	0	0
	0	1	0	3
	2	0	0	1
	18	3	2	4
	0	1	0	0
	23	8	0	4
	0	0	0	2
	0	1	0	3
	13	0	3	1
	0	0	0	0
	19	5	2	1
	43	5	4	5
	0	1	0	0
	13	4	0	0
	0	0	0	0
	0	1	0	0
	3	1	0	0
	20	3	0	3
	0	1	0	0
	3	3	1	4
	0	1	1	0
	0	0	0	0
	12	5	5	8
	0	0	0	0
	0	1	0	0
	0	0	0	0
	15	2	2	7
	24	1	0	5
	28	3	0	4
	48	3	3	3
	1	0	2	2
	19	4	1	14
	2	0	2	3

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
	5	7	1	2
Averages:	9	1	1	2
Number of Researchers: 65				
107 ARC -- Guneid Research Sub-Station				
	4	2	0	3
	9	4	0	1
	3	5	2	3
	4	5	4	6
	3	1	0	0
Averages:	4	3	1	2
Number of Researchers: 5				
108 ARC -- Hudeiba Research Station				
	12	3	4	13
	0	4	1	4
	12	3	4	4
	14	0	0	5
	3	4	0	4
	7	0	0	0
Averages:	8	2	1	5
Number of Researchers: 6				
109 ARC -- Kadugli Research Station				
	0	0	0	0
	0	0	0	4
	5	2	0	2
	2	0	0	3
	1	1	2	0
	0	0	0	0
	0	0	0	0
	5	1	1	3
Averages:	1	0	0	1
Number of Researchers: 8				
110 ARC -- Kassala Research Station				
	8	3	5	1
Averages:	8	3	5	1
Number of Researchers: 1				

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
111 ARC -- Matug Research Station				
	4	1	0	4
Averages:	4	1	0	4
Number of Researchers: 1				
112 ARC -- New Halfa Research Station				
	3	1	0	0
	2	0	0	4
	3	3	0	2
	0	2	3	3
	19	1	0	1
	10	1	3	4
Averages:	6	1	1	2
Number of Researchers: 6				
113 ARC -- Obeid Research Station				
	7	1	2	3
	4	0	0	0
	5	1	1	4
	0	1	0	2
	2	1	0	2
	4	1	4	0
	12	1	5	5
	4	3	1	2
	2	2	0	5
	3	0	0	3
	0	1	1	1
	7	1	0	5
Averages:	4	1	1	2
Number of Researchers: 12				
114 ARC -- Rahad Research Station				
	0	1	0	4
	15	0	0	0
	2	3	0	6
	9	1	1	3
	2	3	3	0
Averages:	5	1	0	2
Number of Researchers: 5				

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
115 ARC -- Sennar Research Station				
	5	0	2	1
	15	0	1	0
	8	0	0	1
	5	0	1	0
Averages:	8	0	1	0
Number of Researchers: 4				
116 ARC -- Shambat Research Station				
	6	3	1	0
	11	4	0	3
	2	0	0	1
	14	3	0	8
	2	3	3	3
	0	1	1	7
Averages:	5	2	0	3
Number of Researchers: 6				
117 ARC -- Shendi Research Station				
	7	0	1	2
	13	1	0	0
Averages:	10	0	0	1
Number of Researchers: 2				
118 ARC -- West Sudan Research Headquarters				
	12	2	1	5
Averages:	12	2	1	5
Number of Researchers: 1				
119 ARC -- Wildlife Research Center (Khartoum)				
	3	2	0	2
	5	6	0	3
	5	1	0	1
	0	1	0	0
	0	3	0	2
	0	1	0	1
	2	2	0	1
	1	5	0	0

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
	-----	-----	-----	-----
Averages:	2	2	0	1
Number of Researchers: 8				
201 APVR -- El Huda Animal Products				
	17	1	0	2
	-----	-----	-----	-----
Averages:	17	1	0	2
Number of Researchers: 1				
202 APVR -- Soba Veterinary Research Laboratory				
	3	3	1	0
	18	2	1	1
	10	3	3	4
	15	1	0	2
	7	1	0	0
	29	3	0	0
	0	7	2	2
	54	4	5	6
	7	1	2	5
	0	3	5	3
	21	2	0	0
	33	1	2	3
	-----	-----	-----	-----
Averages:	16	2	1	2
Number of Researchers: 12				
203 APVR -- Strukaba Animal Products				
	6	0	0	0
	2	0	0	0
	0	0	0	0
	-----	-----	-----	-----
Averages:	2	0	0	0
Number of Researchers: 3				
204 APVR -- Um Benien Animal Products Research				
	1	0	0	0
	-----	-----	-----	-----
Averages:	1	0	0	0
Number of Researchers: 1				
301 NRC -- Economic and Social Research Council				
	5	2	0	6

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
	4	1	0	3
	0	0	0	1
	1	2	1	1
	3	0	0	2
	6	0	0	2
Averages:	3	0	0	2
Number of Researchers: 6				
302 NRC -- Agricultural Research Council				
	11	2	1	4
	6	1	0	2
	3	4	0	8
Averages:	6	2	0	4
Number of Researchers: 3				
401 PI -- Abu Haraz				
	2	2	0	0
	0	4	1	2
	0	1	0	2
	2	2	0	0
	2	0	0	0
	0	0	0	0
	1	1	0	1
	0	0	0	0
	0	0	0	1
Averages:	0	1	0	0
Number of Researchers: 9				
402 PI -- Abu Naamu				
	0	3	0	0
	2	2	0	0
	0	1	0	0
	0	1	0	0
	0	0	0	0
	0	0	1	1
Averages:	0	1	0	0
Number of Researchers: 6				
403 PI -- Koko				
	4	1	0	2
	1	1	0	2

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
	5	1	0	0
	1	0	0	0
	0	1	0	1
	4	0	0	0
	2	1	0	0
	0	0	0	0
	0	2	0	2
	1	1	0	2
	-----	-----	-----	-----
Averages:	1	0	0	0

Number of Researchers: 10

404 PI -- Shambat

	0	1	0	2
	0	0	0	5
	0	0	0	0
	0	0	0	0
	7	3	1	1
	10	5	0	17
	4	1	0	0
	1	1	0	1
	6	2	0	6
	0	1	0	5
	2	4	2	7
	3	2	0	0
	0	0	1	0
	2	2	0	4
	0	0	0	0
	-----	-----	-----	-----
Averages:	2	1	0	3

Number of Researchers: 15

405 PI -- Soba

	0	0	0	1
	0	0	0	1
	0	0	0	0
	0	1	1	2
	0	0	0	0
	2	1	3	0
	0	0	0	0
	0	1	0	3
	-----	-----	-----	-----
Averages:	0	0	0	0

Number of Researchers: 8

501 UNI -- Department of Agricultural Engineering

	0	1	0	0

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
	0	0	0	0
	0	0	0	0
	6	3	0	3
	0	0	0	0
	-----	-----	-----	-----
Averages:	1	0	0	0

Number of Researchers: 5

502 UNI -- Faculty of Agriculture

	17	3	0	1
	5	3	0	2
	3	2	1	0
	3	1	1	0
	4	1	2	4
	26	3	1	4
	0	2	0	0
	6	3	0	0
	24	4	2	3
	0	2	0	0
	7	0	0	3
	7	2	0	3
	3	2	0	1
	0	3	0	3
	10	3	3	7
	3	0	0	0
	0	1	0	0
	2	2	0	2
	0	0	0	0
	9	6	0	1
	40	2	1	3
	0	4	1	4
	0	0	0	0
	0	0	1	0
	0	2	2	0
	0	0	0	0
	4	2	4	5
	5	0	0	0
	2	0	0	0
	0	0	1	0
	6	2	0	0
	2	3	1	1
	19	4	0	2
	0	1	2	0
	0	0	0	0
	0	1	0	3
	6	2	0	2
	17	1	1	1
	0	2	0	2
	0	0	0	0
	0	3	2	3
	0	4	1	3

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
	2	1	0	5
	3	4	0	2
	0	0	0	0
	0	4	2	2
	4	3	0	0
	0	1	0	2
	0	1	1	1
	12	4	0	0
	2	0	0	0
	0	0	0	1
	1	7	3	6
	2	2	0	3
	0	2	0	0
	2	2	1	3
Averages:	4	1	0	1

Number of Researchers: 56

503 UNI -- Faculty of Veterinary Science

	14	3	0	0
	15	2	1	4
	8	4	0	7
	5	2	0	3
	0	2	0	0
	39	9	2	3
	0	2	0	0
	28	4	3	5
	3	1	0	0
	14	3	0	0
	12	4	0	8
	15	3	0	6
	23	4	0	3
	31	4	0	0
	20	3	1	4
	9	3	0	1
	3	3	0	0
	0	1	0	0
	0	0	0	0
	4	0	0	0
	6	3	0	5
	13	2	0	0
	19	4	0	0
	7	1	0	2
	0	8	1	4
	47	2	1	0
	0	0	0	0
	37	1	3	5
	27	1	8	0
	30	2	0	0
	0	0	0	0
	0	6	0	3

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
	0	2	0	0
	0	0	0	0
	-----	-----	-----	-----
Averages:	12	2	0	1

Number of Researchers: 34

504 UNI -- Institute of Animal Production

	3	3	0	1
	0	1	0	0
	0	0	0	0
	0	3	1	1
	10	4	3	1
	16	2	0	0
	7	0	0	0
	25	2	0	3
	10	4	0	0
	0	0	0	0
	13	3	1	0
	-----	-----	-----	-----
Averages:	7	2	0	0

Number of Researchers: 11

505 UNI -- University of Gezira

	2	4	0	6
	2	0	0	1
	0	0	0	2
	3	3	1	1
	21	2	2	0
	1	3	1	2
	47	3	1	3
	2	1	2	3
	24	4	6	3
	0	0	0	0
	4	3	1	0
	0	3	2	8
	0	0	0	1
	23	6	7	4
	1	1	0	1
	0	0	0	2
	4	2	0	2
	6	0	0	3
	0	0	0	0
	0	2	1	1
	0	5	2	3
	2	3	0	2
	2	1	0	2

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
Averages:	6	2	1	2

Number of Researchers: 23

APRA Human Resources Inventory
Summary of Professional Indicators

(Prepared and provided by APRA Management
on August 2-3, 1988)

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
Headquarter (H.Q.) Animal Production Research Admin. (APRA)				
	39	6	1	9
Number of Researchers: 6				
Kuku - Poultry Research Centre				
	2	3	-	3
Number of Researchers: 5				
Kuku - CANRL Nutrition Lab.				
	14	6	-	7
Number of Researchers: 6				
Kuku - Meat & Fattening Section				
	23	3	-	6
Number of Researchers: 4				
Umm Benin Research Station (APRA)				
	7	4	-	4
Number of Researchers: 6				

INSTITUTION CODE AND NAME	NUMBER OF PUBLICATIONS	PROFESSIONAL SOCIETIES	AWARDS RECEIVED	MEETINGS ATTENDED
El Shukaba - Dairy Research				
	12	7	-	4
Number of Researchers: 8				
Ghazala Gawazat Animal Production				
	-	-	-	-
Number of Researchers: 1				
El Huda - Sheep Research Station				
	24	3	-	4
Number of Researchers: 4				
Atbara - Dairy				
	-	3	-	-
Number of Researchers: 4				

SUDAN ATMS Human Resources Inventory

Table 7b: Summary of Professional Indicators by Discipline

02/01/88

DISCIPLINE CODE AND NAME	TOTAL # OF RESEARCHERS	AVERAGE # OF PUBLICATIONS	AVERAGE # OF PROFESSIONAL SOCIETIES	AVERAGE # AWARDS RECEIVED	AVERAGE # MEETINGS ATTENDED
1000 AGRICULTURE IN GENERAL	11	2	1	0	1
1100 EDUCATION, EXTENSION, AND INFORMATION	2	0	1	0	2
1300 AGRICULTURAL ECONOMICS, DEVELOPMENT , AND RURAL SOCIOLOGY	23	2	1	0	2
1400 PLANT SCIENCE AND PRODUCTION	94	6	1	1	2
1500 PLANT PROTECTION	38	6	1	1	2
1600 ENTYMOLOGY	20	7	2	1	2
1700 FORESTRY	18	3	1	0	1
1800 ANIMAL SCIENCE AND PRODUCTION	86	10	2	0	1
1900 FISHERIES	4	9	3	1	11
2000 AGRICULTURAL MACHINERY AND ENGINEERING	25	1	1	0	0
2100 NATURAL RESOURCES AND ENVIRONMENT	42	4	1	0	1
2200 FOOD SCIENCE	21	10	2	0	2

SUDAN ATMS Human Resources Inventory

Appendix 1: List of Educational Specializations

02/01/88
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CODE	SPECIALIZATION
1000	AGRICULTURE IN GENERAL
1010	Marketing
1020	Business Management
1100	EDUCATION, EXTENSION, AND INFORMATION
1110	Education
1120	Extension
1200	ADMINISTRATION
1300	AGRICULTURAL ECONOMICS, DEVELOPMENT , AND RURAL SOCIOLOGY
1310	Agricultural Economics
1311	Mathematics and Statistics
1312	Development economics and policies
1320	Rural Sociology
1400	PLANT SCIENCE AND PRODUCTION
1410	Agronomy
1411	Vegetable Crops
1420	Horticulture
1421	Pomology
1430	Botany
1440	Plant Genetics and Breeding
1441	Cotton Breeding
1450	Crop Physiology
1500	PLANT PROTECTION
1510	Plant Pathology
1520	Weed Science
1530	Herbicides and Pesticides
1600	ENTYMOLOGY
1700	FORESTRY
1800	ANIMAL SCIENCE AND PRODUCTION
1810	Animal Husbandry
1811	Dairy Science
1812	Meat Science
1813	Poultry Science
1820	Animal Nutrition
1830	Veterinary Science
1831	Veterinary Epidemiology
1832	Veterinary Pathology
1833	Veterinary Histology
1840	Zoology

CODE	SPECIALIZATION
1900	FISHERIES
1900	FISHERIES AND AQUACULTURE
1910	Limnology
2000	AGRICULTURAL MACHINERY AND ENGINEERING
2100	NATURAL RESOURCES AND ENVIRONMENT
2110	Environmental Physics
2120	Soil Science
2125	Soil Biochemistry
2130	Marine Studies
2140	Range Science
2150	Wildlife
2200	FOOD SCIENCE
2210	Food Biochemistry