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A Report to the
Government of Kenya

Kenya's National
Agricultural Research System

ISNAR

International Service for National Agricultural Research

The International Service for National Agricultural Research (ISNAR) began operating at its headquarters in The Hague, Netherlands on September 1, 1980. It was established by the Consultative Group on International Agricultural Research (CGIAR) on the basis of recommendations from an international task force, for the purpose of assisting governments of developing countries to strengthen their agricultural research. It is a non-profit autonomous agency, international in character, and non-political in management, staffing and operations. Most of its funds are provided by an informal group of approximately 30 donors: countries, development banks, international organizations and foundations, which make up CGIAR.

ISNAR is the youngest of the 13 centers in the CGIAR network, and it is the only one which focuses primarily on national agricultural research issues. It provides advice to governments, upon request, on organization, planning, manpower development, staff requirements, financial and infrastructure requirements, and related matters, thus complementing the activities of other assistance agencies. Additionally, ISNAR has an active training and communications program which cooperates with national agricultural research programs in developing countries.

ISNAR also plays an active role in assisting these national programs to establish links with both the international agricultural research centers and donors.

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Agricultural Research System**

September 1981

ISNAR

**International Service for National Agricultural Research
P.O. Box 93375, 2509 AJ, The Hague, Netherlands**

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SUMMARY

Background of the Study

The purpose of the present study, conducted at the request of the Government of Kenya, has been to review Kenya's agricultural research system. The Government of Kenya is placing emphasis on agricultural growth and development as a means of achieving its goals of improving nutrition, creating employment and income-earning opportunities, and alleviating poverty. It recognizes the critical need for improved agricultural productivity to cope with both its problems of population growth and food shortages and its longer-term problems of self-sustaining and balanced economic growth. It also recognizes the critical role of agricultural research in generating and applying the improved technologies necessary for increased agricultural productivity. The Government of Kenya has outlined a national science and technology policy and has created institutions to facilitate the articulation and execution of research strategies and programs based on national priorities. It requested this study in order to sharpen its focus, and it asked that ways be recommended by which it might reform or strengthen its agricultural research system such that it could better meet the national objectives.

Terms of Reference

In the agreed Terms of Reference, the review team was requested to pay specific attention to the structure, organization, and management of the agricultural research system; to the determination of its research policies, programs, and priorities; to its generation and application of productive research knowledge; to the gaps in its research, services, and training; and to the overall needs for strengthening the total system. The team was also expected to review the objectives, plans, and achievements of the government and its various institutions in agricultural research and production.

Review Procedures

The study was carried out in Kenya during the period June 22 to July 24, 1981. The review team visited the major stations and headquarters of the agricultural research services in Kenya; it held discussions with various authorities in many of the major research and research-related institutions, including educational and development institutions (see Itinerary Annex 3 to the main report); and it consulted with persons responsible for the planning and execution of research at virtually all levels. About 250 scientists, administrators, planners, and other personnel were consulted. The team also reviewed available reports and documentation on agricultural research in Kenya.

Information was obtained on -- with an assessment carried out of -- the orientation, constraints, and relevance to the defined problems of present research programs. The team attempted to determine the adequacy of the research facilities and manpower in relation to the high priority

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problems in food and export crops, livestock, and forest resources production; and to assess the basis for determining priorities among programs and projects. It also studied the existing relationships between agricultural research and the agricultural research delivery systems, as well as the effectiveness of communication within and between the systems.

Form of Report

The report discusses agriculture in general in Kenya and, more specifically, agricultural development under Kenya's Development Plan 1979-1983. It then covers the background and historical development of the organization of agricultural research in Kenya. The organization of present research programs is described in some detail, along with the allocation and utilization of resources in agricultural research, the research delivery systems, and external support. While the report attempts to identify needs and to assess those aspects of agricultural research outlined in the terms of reference, it does not attempt to establish or formulate an agricultural development strategy; a task already comprehensively carried out in Kenya's Development Plan 1979-1983. It does attempt to provide a positive framework for the evolution of the organization and management of agricultural research so that this research can play its crucial productive role in development. The major findings and recommendations in relation to the terms of reference are presented in Chapter 9 of the main report. The review team believes that some deficiencies identified in research planning and execution, training, and communication can be effectively corrected within the comprehensive organization already initiated by Kenya itself, and which the report recommends should be stabilized and strengthened.

Summary of Findings and Recommendations

General

The team acknowledges the excellent progress that has been made in the growth of the agricultural economy. Agricultural research has made significant contributions to that growth through the introduction, generation, adaptation, and application of improved technologies; it has contributed significantly to increased productivity of major export crops and some food crops. The team found in place an extensive research system which had been developed to meet successfully a variety of demands over the years. Within the system persons were actively considering how it could adapt to meet the recognized, urgent demands for further improvements in food and agricultural productivity. The team found that the major challenges for the future will be in the development and application of research-generated technologies appropriate to smallholder food, tree crop, and livestock farming, particularly in the areas of medium and low production potential, and in creating and sustaining an integrated, responsive, and increasingly productive research system that is able to contribute more effectively to the improved performance of agriculture.

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The team identified needs for a number of positive actions that should reduce existing constraints and improve the system's ability to meet the challenges before it. These needs are: to develop a more unified, comprehensive, and cohesive organization for the planning, promotion and execution of research -- including the determination of research priorities and allocation of resources; to strengthen communications systems, for internal coordination in the research organization and for the delivery of research results to the agricultural extension services and farmers; to increase the supply of well-trained and experienced manpower, along with improving the research environment; to provide more socio-economic inputs into definition, execution, and implementation of research activities; and to implement the small farmer-oriented research strategy more determinedly.

Organization

The most crucial and fundamental conclusion is that there is needed a functional, semi-autonomous, comprehensive, and cohesive organization charged with the responsibility of planning, executing, and supervising a coordinated agricultural research program for the nation.

A step towards creating such a comprehensive organization was taken in the Science and Technology Act (as amended in 1979) Cap. [250 of the Laws of Kenya and in the establishment of the Kenya Agricultural Research Institute (KARI) as "a body corporate with perpetual succession and a common seal" with the function of carrying out research in the fields of Agriculture, Veterinary Science and Forestry, as well as other things as specified in Section 14 (a)-(f). In addition, the Development Plan 1979-1983, Section 6.89, provides for "combining the research services of the Ministry of Agriculture (and the Ministries of Livestock Development and Environment and Natural Resources) with the agricultural research services of the former East African Community (now KARI) to form a new comprehensive agricultural research organization."

For the purposes of legislative and administrative convenience, the team suggests the designation KARI (Kenya Agricultural Research Institute) be retained for this organization.* However, it is not recommended that the present KARI, which in effect is a remnant of the old EAAFR0/EAVRO, take over all the agricultural research functions, stations, and responsibilities of the ministries; rather it is urged that there be a mutually agreed upon amalgamation of agricultural research functions, programs, and projects, with all parties to the amalgamation playing parts in shaping the focus, orientation, and priorities of the new organization.

*If, because of past association or identification with EAAFR0/EAVRO or other reasons, the designation KARI is unacceptable, the team suggests the adoption of the designation Kenya Agricultural Research Organization (KARO) for such a unified, comprehensive agricultural research organization and service.

The functions defined in the law for the Agricultural Research Institute are considered adequate, and the provision for a semi-autonomous Board of Management with well-defined responsibilities should be sufficient to guarantee efficient services, flexibility, relevance, and scientific quality. In order to facilitate close interaction with the Ministry of Agriculture and other participating ministries, the directorate of the comprehensive research organization should maintain close liaison with the ministries through a system of research liaison scientists.

Because of the need for the comprehensive organization to take a central role in the planning, execution, management, and supervision of agricultural research, it is probably preferable not to identify it with the Muguga Station or with any provincial or regional station. Muguga has a distinct role as a national research station with specialist research responsibilities, e.g., for plant quarantine, virology, etc.

Specialized research and research-related services, such as the plant quarantine, vaccine production and testing, virology, and biological control, are also integral parts of the research system. It is preferable that such services as are at present at Muguga, NAL, and Veterinary Laboratories Kabete remain there and that they be integrated into the development of the entire research system. Research efforts in livestock production should also be integrated, especially in such areas as pasture and fodder production and preservation, mixed farming, and animal use in farming systems.

The number and activities of research stations and substations need further study and rationalization. For example, national research stations could take responsibility for multi-disciplinary research in the improvement of crops, or groups of crops, commodities, and animals; regional research stations could emphasize farming system approaches aimed at developing agricultural production packages of technologies adapted to the various agro-ecological zones; and substations could serve as testing sites for both national and regional research stations. There is a need for a "critical mass" of research scientists at both national and regional research stations, but substations could be managed by experienced technical staff with supervision from the main stations.

Fiscal Procedures

A considerable degree of self-accounting and financial responsibility, within the framework of acceptable standards of government accountability, is recommended for the proposed organization and its component research stations. This would require strengthening the accounting, administration, and other supporting staff both at headquarters and at the major national and regional research stations. The present system of financial administration, involving centralized approval of vouchers and the procurement procedures, appears to impose a constraint on performance and productivity; the team believes change is justified.

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Planning

The team could not identify a clear and functional system for the planning of research and the establishment of research priorities and programs. It appeared that inexperienced research station staff often received little guidance in translating broad agricultural policy guidelines into research programs, in identifying researchable problems, and in establishing their relevance to farmers' problems. Nor did there appear to be a consistent method of evaluating and approving proposals emanating from these stations.

The Agricultural Sciences Advisory Research Committee (ASARC) is expected to take care of this activity when that committee becomes fully operational. However, formal machinery will be needed for taking the advice of ASARC into consideration when decisions are made concerning approval of proposed programs and projects and allocation of resources on the basis of established research priorities.

The needed periodic planning and review of all agricultural research programs could be undertaken by ASARC in collaboration with KARI, directors of stations, the NCST, the agricultural extension services, university staff, farmers, and other research scientists.

The team noted particularly the need for integration of research efforts in livestock production, especially in the areas of pasture and fodder production, mixed farming, and animal use in farming systems.

Research and Extension Liaison

The existing linkages between agricultural research, agricultural extension, and the farmer depend on formal and informal systems of communication, most of which are not as efficient as they could be. Communication within the research system and with the world scientific community could be improved. Since effective communication is the core of the research system, and two-way communication between research and extension and between them and the farmer is needed, the team recommends that a special Department of Agricultural Extension-Research Liaison and Communication be established within the suggested comprehensive organization. The nucleus of such a department could be formed by combining the present documentation service at KARI, the National Agricultural Information Center (NAL) and the Agricultural Documentation Center in the Ministry of Agriculture. It could then be expanded to fulfill the role envisaged for it.

The department would be responsible for moving relevant information within the research system and between the research system, the extension service, and other user organizations. It would also be responsible for eliciting feedback from users to guide further research.

In addition, the department could serve a supporting role as the proposed comprehensive organization develops an effective channel of communication between research stations and International Agricultural Research Centers (IARC). The roles of IARCs and the Kenyan agricultural

research system are complementary; a means is needed for maintaining an awareness of relevant areas of research and technological development in IARCs which could be beneficial to the Kenyan agricultural research system. Although linkages and collaboration with the IARCs exist, there is a need for more cooperation through free and assisted exchange of materials and information and also through joint intellectual activities in research and program planning.

Training

One of the major weaknesses of the present system is the acute shortage of well-trained agricultural research scientists and technical support personnel. Of the 390 Kenyan research officers, less than 15 percent have advanced qualifications or training for research. In addition to agricultural scientists who are well-trained in their own disciplines, the research system needs those who, by training and experience, are sensitive to wider aspects of technical, environmental, and socio-economic research, and who could offer leadership in formulating priorities.

Although it appears that a major and consistent input into the training of scientific research personnel and technicians is required, the team was unable, in the time available, to define the precise extent and areas of these needs. Consequently, it recommends the immediate undertaking of a feasibility study of scientific manpower requirements and training needs and to immediately enhance the existing training program. In addition, it recommends that 35 to 40 fellowships in the areas defined in the report be sought through technical assistance in the next year or two.

Since the agricultural education system, university and technical, plays a role in providing the manpower necessary for agricultural research, the team strongly endorses the present plans for establishing a postgraduate school for the Faculties of Agriculture and Veterinary Medicine; for establishing or strengthening undergraduate programs in animal production and forestry; and for expanding the training of support staff. It recommends the re-introduction of the Diploma Course in Forest Resources Management at the Egerton College in order to produce broad-based, intermediate level manpower for research and development in forestry. It also recommends the strengthening of the postgraduate program in agricultural economics at the University of Nairobi in order to facilitate greater socio-economic inputs into the country's agricultural research.

In addition to formal education programs, there is need for greater involvement of willing university staff in research projects in their areas of expertise. This could be accomplished through increased opportunities and more flexible arrangements for their participation in research and in training of higher-level manpower.

Research Environment

The shortage of well-trained and experienced research personnel is aggravated by a high rate of turnover and a failure to retain some highly

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experienced staff. The team felt that this could be accounted for, at least in part, by some apparent deficiencies in the research environment. Physical, social, remunerative, intellectual, and organizational aspects must be taken into consideration in creating a favorable research environment.

Inadequate physical facilities and social amenities were observed at some of the national and regional research stations. Improvement of these facilities and provision of social amenities are considered essential for research, for the healthy development of the research scientists and their families, and for their stability in postings.

In regard to remuneration and rewards for research personnel, the team believes that it is preferable to have a scheme of service which is not geared principally to management or administrative functions. One which is based mainly on research functions (as is the case in the Coffee Research Foundation), and which is flexible and provides opportunities for advancement as a reward for scientific competence and research productivity, could facilitate the recruitment and retention of highly qualified research personnel. The "Scheme of Service" approved by the Directorate of Personnel for Research Institutes and applied in other Research Institutes, e.g., KMRI and KETRI, is recommended.

The team also recommends creating increased opportunities for research personnel to continue their professional development. This could be done through in-service training, conferences, seminars, and other awards. The facilities and programs at the IARCs should be explored for relevant short-term research and production training.

Socio-economic Inputs

Although the team noted a trend toward introducing socio-economic inputs into the identification of research problems and the planning, execution, and evaluation of research projects, only a few of the research stations have begun its implementation. This is due, apparently, to a shortage of trained agricultural economists who could work hand in hand with the technical scientists. A recommendation concerning this is included in the discussions on training

Since socio-economic inputs in the planning and execution of research could facilitate the development of appropriate technologies, this trend needs to be stabilized and sustained. To this end, the team recommends the creation of a Department of Socio-economics and Statistics at the directorate of the comprehensive research organization. Steps should also be taken to strengthen socio-economic inputs in the research work at all national and regional stations.

Small-holder Farmers

There was no convincing evidence that major emphasis is being placed on the development of production technologies for the small-holder farmer. The most appropriate step would appear to be for the regional research stations to orient their research programs within the framework

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of a farming systems approach that would generate appropriate production technologies for small-holder farmers in the specific agro-ecological zones in which they are located. This would include crop and livestock production and forest resources management. Although this is likely to be more difficult and expensive than traditional disciplinary research, it has the potential to enable small-holder farming to make a reliable and sustained contribution to total agricultural output.

Participation in Major Donor Projects

The Government of Kenya should place a high priority on support of the major projects of research and development currently being supported by donor agencies, e.g., the FAO/UNDP Dryland Farming Research and the Kiboko Range Research Project. Kenya's full participation would ensure that training opportunities are well utilized for its research personnel. In addition, Kenya's participation and full commitment could ensure the continuation and possible expansion of these projects, which provide a major focus in improving the productivity of the semi-arid and marginal areas of food production.

Conclusion

Substantial assistance will be required for Kenya to strengthen the organization and management of its agricultural research system; to train manpower in various areas of crops, livestock, and forestry research; and, initially, to organize and staff the proposed new departments of Agricultural Extension/Research Liaison and Communication and Socio-economics and Statistics. A feasibility study proposed as a follow-up to this report could determine the precise levels of assistance needed. It would be advisable to develop a consortium of donors which have these interests and expertise in order to assist Kenya in strengthening areas identified as having high priority. ISNAR would, if requested, be willing to assist the Government of Kenya in the formation of such a consortium.

The team believes that the adoption of the recommendations outlined in this report can improve the efficiency, productivity, and responsiveness of the agricultural research system in Kenya and strengthen its capacity for effective, self-sustaining growth and contributions to national agricultural development.

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Preface

This report has emanated from a 4-week on-site review of the agricultural research system of Kenya in June/July, 1981. The review was carried out at the request of the National Council for Science and Technology, on behalf of the Government of Kenya, by an ISNAR team comprising Dr. T. Ajibola Taylor of ISNAR (Team Leader); Dr. M. Dagg (ISNAR); Dr. H. Kriesel, Dr. H. Messerschmidt and Dr. L. Roche (ISNAR Consultants) with contribution from Mr. S.N. Muturi (NCST), Dr. F.W. Wang'ati (NCST), and Dr. S. Chema (NCST). The Team was assisted in discussions and deliberations by many Kenyan administrators, policymakers, research scientists and educationists, but they do not all necessarily subscribe to the conclusions and recommendations embodied in the Report.

ACKNOWLEDGMENTS

The members of the Review Mission would like to express their indebtedness, appreciation and gratitude to all the staff in Kenya's agricultural research system, many of whom gave their valuable time and efforts in the preparation of documents, the demonstration and illustration of program activities, problems and constraints, and the discussions of possible solutions, during the visits to the offices, laboratories, training institutions, research stations and sub-stations connected with agricultural research in Kenya. Many of these kind and dedicated agricultural scientists are too numerous to list, and the Team therefore makes no attempt to present an Annex of the list of persons met.

The Team would like, however, and in particular, to thank the Executive Secretary of the NCST, Professor P. Gacii, for his interest, support and facilities throughout the period of study; the Science Secretary of the NCST, Mr. S.N. Muturi, who, in addition to being a member of the Team, was largely responsible for the satisfactory organization of the logistic support and the programs of field visits, contacts and appointments; and many other officials and leaders who provided valuable advice and suggestions.

The Team's special thanks go to the Minister of Agriculture, the Hon. G.K. M'Mbijjewe, E.G.H., M.P., and the Minister for Livestock Development, the Hon. Dr. Mango, M.P., and the Permanent Secretaries and Deputy Secretaries of their Ministries, for their sustained interest in the work of the Team and for granting audience to the Team for a mutually-beneficial and stimulating discussion of the major issues, and the findings and recommendations of the Team. The Team is also grateful to the Directors of Agriculture, Livestock Development, their Deputies, and the Directors of Research of both Ministries, and the Chief Conservator of Forests for the valuable time devoted individually and jointly to the range of investigations and discussions held with them on the organization and management of the research system, the various aspects of its activities and programs, and the ways in which these might be strengthened to achieve greater flexibility and efficiency.

Among others whose contributions to deliberations and discussions deserve special mention and appreciation are the Deans of the Faculties of Agriculture and Veterinary Medicine, University of Nairobi; the Chairman of the Board of Management and the Director of KARI; the Director of KETRI; the Heads of the Departments of Forestry and Range Management; the Principal of Egerton College, and his staff; the representatives of the IARCs (including ICRAF and ICIPE) with Headquarters or research program activities in Kenya; the Directors and Officers-in-Charge of all the laboratories and stations visited; the Managing Director of the Kenya Seed Company; the Provincial Director of Agriculture (Coast) and his staff; and the many other scientists and research personnel who stimulated thoughts and discussions, and made very valuable suggestions to the Team.

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Although the findings, conclusions and recommendations are based on information obtained during the extensive travel, visits, meetings and discussion sessions with nearly all levels of personnel in Kenya's agricultural research system, and on a review of the documentation made available to the Team, the report is that of the Study Team. It represents the synthesized views of members of the Team after considerable discussions and exchange of views; and the Team accepts responsibility for the Report. It is, however, both the feeling and the hope of the Team that the Report reflects adequately the aspirations of the Kenya authorities in strengthening Kenya's national agricultural research system to meet the challenges of food and economic welfare in both the immediate and distant future.

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LIST OF ABBREVIATIONS

ADC	Agricultural development Corporation
AHITI	Animal Husbandry Industry Training Institute
ARCS	Advisory Research Committees
ASARC	Agricultural Sciences Advisory Research Committee
CARS	Coast Agricultural Research Station
CIAT	Centro Internacional de Agricultura Tropical
CBD	Coffee Berry Disease
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CIP	Centro Internacional de la Papa
DA	Director of Agriculture
DAO	District Agricultural Officer
DDA	Deputy Director of Agriculture
DEO	District Extension Officer
DOR	Director of Research
EAC	East African Community
EEAFRO	East African Agricultural and Forestry Research Organization
EATRO	East African Trypanosomiasis Research Organization
EAVRO	East African Veterinary Research Organization
ECF	East Coast Fever
FAO/UNDP	Food and Agricultural Organization/United Nations Development Program
IAEA	International Atomic Energy Agency
IARC	International Agricultural Research Centre
IADP	Integrated Agricultural Development Project
IBRD	International Bank for Reconstruction and Development
ICARDA	International Center for Agricultural Research in Dry Areas
ICRISAT	International Center for Research in the Semi-Arid Tropics
ICIPE	International Center of Insect Physiology and Ecology
IDRC	International Development Research Center
IDS	Institute of Development Studies
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Center for Africa
ILRAD	International Laboratory for Research in Animal Diseases
ISNAR	International Service for National Agricultural Research
KADOC	Kenya Agricultural Documentation Center
KARI	Kenya Agricultural Research Institute
KARO	Kenya Agricultural Research Organization
KETRI	Kenya Trypanosomiasis Research Institute
KMRI	Kenya Medical Research Institute
KREMU	Kenya Rangeland Ecology Monitoring Unit
KTDA	Kenya Tea Development Authority
LEO	Locational Extension Officer
LU	Livestock Unit
MINAG	Ministry of Agriculture
MLD	Ministry of Livestock Development
NAL	National Agricultural Laboratories
NRS	National Research Station
NCST	National Council for Science and Technology
NSQCS	National Seed Quality Control Service

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PDA	Provincial Director of Agriculture
PARAC	Provincial Agricultural Research Advisory Committee
PRAC	Provincial Research Advisory Committee
R and D	Research and (Experimental) Development
RRAC	Regional Research Advisory Committee
RRS	Regional Research Station
SDDA	Senior Deputy Director of Agriculture
SRD	Scientific Research Division
SS	Sub-Station
TPRI	Tropical Pesticides Research Institute
VIL	Veterinary Investigation Laboratory
WHO	World Health Organization

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CHAPTER 1 GENERAL INTRODUCTION

1.1 Origin of the Mission

As a followup to the approaches made to the Director General of ISNAR, Dr. W. K. Gamble, by the Kenya delegation to the International Centers' Week (Manila, November 1980), in respect of ISNAR's possible involvement in assisting to strengthen Kenya's agricultural research system, the Director-General visited Nairobi, Kenya, later in 1980 and held discussions with officials of the Ministry of Agriculture (MINAG) and the National Council for Science and Technology (NCST) of the Office of the President. The visit and subsequent correspondence led to an exploratory visit by Dr. T. Ajibola Taylor, ISNAR Senior Research Fellow, in March 1981. During this visit, agreement was reached as to the specific need for a mission to review Kenya's agricultural research system, and formal terms of reference were approved. On the basis of these agreed terms of reference, a formal request was addressed to ISNAR by the Executive Secretary of the NCST on 13 March 1981 (Annex 1). By a letter dated 1 April 1981 (Annex 2), the Director General indicated ISNAR's agreement to mount a review mission to visit, study, and review Kenya's agricultural research system in June and July 1981.

1.2 Terms of Reference

The following terms of reference, developed in consultation between ISNAR and the NCST and approved by the Government of Kenya, formed the basis of the review:

- (1) To study Kenya's agricultural research system and to advise on the structure, organization, and management necessary to achieve its functions as contained in the various policy documents and the Science and Technology Act Cap. 250 of the laws of Kenya.
- (2) To assess the state of agricultural research in Kenya in terms of levels of knowledge, levels of production, and the urgency of the need for increased agricultural production.
- (3) To assess Kenya's national agricultural research policies, priorities, and organization and to recommend on orientation of these to achieve increased agricultural productivity (production and efficiency on sound economic basis) and development in Kenya.
- (4) To examine possible gaps in the research, support services, and training programs of Kenya's agriculture and, if any, to recommend ways for filling these gaps.
- (5) To assess the methods for determining agricultural research projects and disseminating agricultural research findings and, if needed, to suggest measures for ensuring greater impact on national agricultural development.
- (6) To study the internal and external relationships of the national agricultural research system and to determine whether there is a need to improve the effectiveness and efficiency of these relationships.
- (7) To determine whether there is a need for technical and/or financial assistance to strengthen Kenya's national agricultural research system. If so, to specify these needs.

1.3 Composition of the Mission

The review mission was composed as follows:

Prof. T. Ajibola Taylor (ISNAR Staff Member), Team Leader
Dr. Matthew Dagg (ISNAR Staff Member)
Dr. Herbert C. Kriesel - (ISNAR Consultant)
Dr. Heino C. Messerschmidt - (ISNAR Consultant)
Prof. Laurence Roche - (ISNAR Consultant)
and three Kenyan officials
Mr. Stachys N. Muturi - NCST, Kenya
Dr. Fred J. Wang'ati - Ministry of Agriculture, Kenya
Dr. Samson Chema - Ministry of Livestock Development, Kenya

1.4 Program of the Review Mission

The mission visited Kenya during the period 22 June to 23 July 1981. Members of the team visited agricultural research establishments, stations, and offices, and held discussions with persons of many levels in the agricultural research, research-related, and extension services of Kenya. The details of the itinerary are shown in Annex 3. The team reported on its major findings and recommendations to the various heads of departments and divisions and the permanent secretaries of the participating ministries on 20 July, and to the ministers of livestock development and agriculture on 21 and 22 July.

CHAPTER 2
AGRICULTURE IN KENYA

2.1 General

The Republic of Kenya, with a land area of 575,000 km², is a country of contrasts in topography, climate, and soils. It is a predominantly agricultural country with 85 percent of its 16 million population engaged primarily in agriculture. Agriculture contributes about 35% of the total gross development product (GDP) per year; it plays a major role in providing food, energy, incomes, and employment for a vast proportion of the population; and it provides raw materials for Kenya's manufacturing and distributing industries. Kenya does not produce oil and has virtually no mineral wealth. (Annexes 4, 5, and 6). Agricultural products constitute 70% of its total exports.

Topography, climate, and soils combine for conditions that vary from Afro-Alpine in the center, to tropical coastal lowlands in the south-east, high rainforest in the southwest, and near-desert to desert in the north (Fig. 2). Temperature, rainfall, altitude, and soils seem to be the most important factors modifying both the climate and the agricultural potential of the various areas. Of the total land area, only about 7% can be described as good agricultural land; a further 33% is considered only largely useful for livestock production, but with some potential for crop production under irrigation and water conservation. The remaining 60% is semi-desert. Land potential, classified in terms of ecological land units, falls broadly into six zones (Pratt, Greenway and Gwyne, 1966) as follows:

- Zone 1: This is about 800 km² at altitudes above the tree line. Vegetation is moorland or grassland, but barren land is common. Land use is limited to water catchment and tourism. (Less than 1% of total land area.)
- Zone 2: This zone is about 53,000 km² and embraces Kenya's indigenous and planted forests. The agricultural potential is high, particularly in the highlands. Coffee, tea, and pyrethrum are important cash crops at higher altitudes. Livestock can be kept intensively on leys, and cotton yields well at lower elevations. (About 9% of total land area.)
- Zone 3: This zone is about 53,000 km² and is of medium agricultural potential. It consists of large-scale mixed farms and major areas of production of hybrid maize, wheat, and barley. Small-scale farms in this zone grow maize, cotton, pulses, groundnuts, and other oil-seeds. Cashew (which has considerable expansion potential) and coconut are important along the coast. Livestock are kept intensively on leys or semi-intensively on improved natural grasslands. (About 9% of total land area.)
- Zone 4: This zone includes about 53,000 km² of land considered to be of only marginal agricultural potential. It is characterized by commercial ranching and subsistence, small-holder crop and livestock farming. Short-season maize, cotton, pulses, and oil-seeds are grown. Considerable expansion and production potential may be realized from increased research. Important concentrations of game occur in this zone. (About 9% of total land area.)

Zone 5: This zone covers over 300,000 km² and is of moderate rangeland development potential. It is the focus of the current and proposed livestock production development and expansion. Wild life resources are important in many areas, but subsistence farming is usually unsuccessful.

(About 52% of total land area.)

Zone 6: This zone includes about 112,000 km² of land in northern Kenya with sparse and erratic rainfall. It is characterized by nomadism and pastoralism based on periodic flushes of annual grass species.

(About 20% of total land area.)

Kenya's agriculture is characterized by dualism: the bulk of the farming population are largely subsistence farmers, growing staple food crops for their own subsistence and little surplus for sale; and a significant small number of commercial farmers producing cash and food crops for local and export sales. This dualism is gradually being transformed with the division of large farms in the high-potential areas into smaller commercial farms and the formation of a continuum from subsistence farming to highly commercialized large-scale farming. A strong agricultural sector is considered not only to be a major contributor to self-sufficiency in food but a requirement for the successful growth of both the secondary and tertiary production sectors of the economy.

In the last two decades agriculture has depended largely on highly productive farming on about 106,000 km², or 18 percent of the land resources classified as having high to medium potential in Zones 2 and 3 (Fig. 2), and to a lesser extent on smallholder farming, more or less at a subsistence level, mainly on 53,000 km² of marginal-potential land (Zone 4). The remaining 72%, which is semi-arid to arid, has only nomadic pastoralists. With the present rate of population increase, it is estimated that the amount of good land per capita may fall from the 1970 figure of 0.88 ha to 0.36 ha by the year 2000 (Kenya: Into the Second Decade (1975)).

The effects of the pressure of population on good land and recent sub-division of such lands are already being felt in terms of declining output and productivity of some of the major crops and animals produced for food and for export. In these circumstances, the greatest challenge is for agricultural research to develop improved production technologies to provide for and sustain increased productivity by small-holder farming in areas of both high and marginal potential. This approach should also be accompanied by a wider application and support of proved technologies for increased production in the higher potential areas, where the limits of potential productivity are now far from being reached.

The World Bank report of 1975 recognized that much of the technological infrastructure and administrative base of the agricultural industry has been laid. Agricultural development has continued to gain momentum, striving to improve living conditions in the rural areas despite the rapid increases in both urban and rural population. It is against this background that the agriculture of Kenya of the 1980s must be set.

2.2 Crop Production

The major food crops are maize, wheat, beans, fruit, and vegetables. Maize is the most important staple food crop in terms of total area

planted and value. Other important food crops include cassava, sweet potato, cowpea, pigeon pea, and sugarcane. Export crops are mainly coffee, tea, pyrethrum, fruits, vegetables, and sisal. Food crops such as sorghum, millet, potatoes, and rice are increasing in importance, and there are indications of efforts to develop these and suitable types of livestock to exploit the productive capacities of the more marginal semi-arid/arid zones. The value of the gross marketed production of all crops for 1980 was estimated at about K £ 265.2 million (Annex 6).

Food is accorded the highest priority in agricultural production, and most of the food produced is consumed or marketed in the rural production areas. It is generally believed that Kenya can be self-sufficient in food production. However, recent trends (even in the absence of droughts and with improving storage practices) indicate shortages of food which might worsen during the decade. For example, the value of imported food and live animals increased from K £ 9.7 million in 1970 to K £ 24.1 million in 1978, including some staple foods which the country was producing in sufficient quantities in the 1960s and at the beginning of the 1970s. The marked decline in the production of the major staples in the last three years, and the resultant importation of food, has focused attention on the need to improve the nation's capacity for increased food production (Annex 7). Although it is considered in some quarters that this is principally a development problem, it is clear that the levels of anticipated efficiency in production will require improved agricultural research strategies and technologies oriented to both the intensive and extensive production conditions of the 1980s and 1990s. The current awareness of the need for increased output and productivity in crops and livestock has been highlighted in two policy papers: National Food Policy Paper (1981), and the National Livestock Development Policy Paper (1980). Both were under discussion during the present mission in Kenya.

2.3 Livestock Production

Livestock production constitutes an important sector in the agriculture of Kenya. The country has a large number of cattle, sheep, goats, pigs, poultry, and camels; livestock products range from meat and dairy products to hides and skin, wool, and eggs. Livestock products are important sources of food in the rural and urban areas; this importance may be underestimated because much of the meat, dairy products, and eggs do not enter the recorded marketed production. Kenya exported meat and dairy products during the 1960s and early 1970s, but there is now an incipient shortage of meat and milk.

The strategy for increasing livestock production has been largely based on the introduction and management of improved livestock breeds in the high- and medium-potential areas. These have led to remarkable achievements in dairy production, both by small-scale and large-scale mixed farms in different parts of this zone. Major achievements have also been recorded in the control of animal diseases. (e.g., rinderpest, foot and mouth disease, and contagious bovine pleuropneumonia), and in the use of artificial insemination for the improvement of the indigenous beef cattle. However, in view of the increasing demand for arable land in the high- and medium-potential areas for food crop production, the livestock industry is now being reoriented towards zero or minimum grazing systems. This will require the intensification of efficient fodder production and some emphasis on dual purpose breeds (for meat and

milk). Higher priority is now being assigned to the promotion of small stock, notably pigs, sheep, goats, and poultry. The focus in this area will involve breeding, improvement, adaptation, and nutrition and management for efficient production. Camels are also expected to receive attention as they are important sources of meat, milk, hides, and transportation in the arid areas. The other important area of livestock development that will require major research inputs is the extension of livestock production to the semi-arid and arid areas and the development of appropriate silvipastoral management systems for these areas. Livestock development programs involving about 4 million ha of land in these areas now focus on range management and the development of group ranches and mixed crop and livestock farming systems. Goats appear to have a great potential in these areas as well as along the coast, where pigs, goats, and poultry are expected to play a major role in livestock production and in the improvement of human nutrition. The effective control and management of animal diseases has been fundamental to achievements in livestock production. The veterinary services are being strengthened through staff training programs, research, and the development of services to improve the prevention and control of animal diseases. Complementary programs of artificial insemination, beekeeping, and livestock marketing are also receiving attention that will enable the integrated livestock research, development, and production program to play a full role in the export economy of the country.

2.4 Forests, Fisheries, and Wildlife

Forests, fish, and wildlife constitute part of the national endowment of renewable resources important to agriculture and rural development. The focus on these resources has been the assessment of their location and actual and potential contribution to sustainable yield through exploitation, replacement, conservation, and management. Although they directly contribute only a small fraction of the GDP, they are important suppliers of the country's fuel, fodder, and pulp, and they provide important sources of animal protein and income. Both planted and natural forests are the principal domestic sources of fuelwood and industrial wood -- and increasingly earners of foreign exchange.

The forests of the nation are generally acknowledged as an important natural resource, as support for industrial uses and for ecological benefits. They play important roles in the provision of basic human needs, as well as in the conservation of soil and protection of water catchments. Previous forest policies have tended to restrict industrial forest exploitation, regulation, and protection; but with the shortage of fuelwood and increasing energy costs, the role of forestry in serving community interests has been brought to the front. This has led to the increasing promotion of the establishment and maintenance of vegetation cover on some public and private lands and to an expansion of provenance trials of tree species appropriate to farming systems and particular end-users.

In the period of 1968-1970 the annual exports of timber were about 30,000 m³, but there has been a decline since 1978. Kenya's remaining indigenous forests cover approximately 2.5 million ha. The strategy to extend, improve, and manage this resource aims at: popularizing community tree planting; establishing forest plantations; emphasizing trees and shrub establishment in the semi-arid and arid areas; integrating rural wood utilization schemes; and managing indigenous and

planted forests as an integral part of land use and development. The pursuit of the rural afforestation program and the proper management of farm wood lots should enable rural communities to become more self-sufficient in forest products on a sustained basis. It is also estimated that by 1986 the yield from plantation forests, being established at the rate of 5,000 to 6,000 ha per annum, should meet the demand for industrial wood. The program of action includes: the further diffusion of the Rural Afforestation Scheme from the present 36 districts to all the districts of the country; the introduction of local afforestation programs; the implementation of the Masai Forest Development Program; the integrated development of forest-based industries; and the strengthening of forestry research. Ten broad goals are spelled out for forestry research in the areas of afforestation techniques, breeding, protection, agro-forestry, and soil and water management.

Although Kenya has a potential annual yield of 150,000 tons of fish from over 10,000 km² of freshwater lakes, 3,200 km of rivers, 640 km of marine coast, and several streams and fishponds, fisheries contribute minimally to the GDP. Kenya is a net importer of fish and fish products. The current strategy emphasises the exploration of these resources so that fish production could make some impact on employment and nutrition. Maximum exploitation on a sustainable basis is being promoted, and fish farming in the rural areas is being developed through the provision of research, extension, and development services. The main thrusts of the fisheries research and development strategy include: the development of mechanized trawling; the improvement of traditional fishing, and the management of its resource base; the improvement and provision of on-shore facilities; and the promotion of inland fish farming. With applied research backstopping in the areas of freshwater fisheries, marine fisheries, and fish farming feasibility studies, improved marketing and training should lead to substantial contributions by fisheries to food and economic welfare in rural areas.

Wildlife is an important natural resource related to food and environment management and to tourism as a source of income. Emphasis has been on conservation and utilization in the primary wildlife locations and on tourism-based activities. A recent approach recognizes the opportunity costs of the other non-wildlife activities, such as ranching and agriculture in these locations, and aims at maximizing returns while minimizing the costs of wildlife development to other sectors. It is planned to develop infrastructure and service to support the carefully planned tourist activities, to review the status of consumptive utilization of wildlife with controlled offtakes and designation of hunting blocks, to initiate conservation programs vital to development, and to locate wildlife-generated benefits more equitably. The research strategy in the Wildlife Conservation and Management Department focuses on the provision of baseline data for planning and management on wildlife resources and their habitats, and training will be strengthened at the Utalii College and the National Wildlife and Fisheries Training Institute, Naivasha. The realization of the programs and projects envisaged in the current plan should be a stimulus to the further contribution of wildlife to food, resources management, and incomes.

CHAPTER 3
KENYA'S AGRICULTURAL DEVELOPMENT

3.1 General Economic Situation

Kenya's post World War II development was mainly in two directions: large-scale agricultural development (mostly in the so-called "white highlands") and the small-scale development elsewhere in the rural sector. The industrial sector consisted of the urban formal sector and the urban and semi-rural nonformal (small-scale) sector. The industrial sector was stimulated by (1) development of import substitution industries, often with some protection; (2) natural endowments, especially at Nairobi as the regional center for transnationals and a number of international agencies, and (3) an expanding tourist business. Most of the productive enterprises were simply transferred from the more developed areas of the world; they are relatively capital intensive, involving a high proportion of non-African and overseas capital and management. There has been little location-specific research and development to give them distinct comparative advantages. The nonformal sectors -- both rural and urban -- have lagged behind the urban formal sector, which has benefited from a substantial net transfer of resources from the agricultural sector. Moreover, a large proportion of the resources that went into agriculture through the 1960s and early 1970s was for land transfer rather than for development per se.

Under conditions of relatively light density of population and measures to restrict use of fertile highlands to large-scale agricultural units, temperate zone crops and animal enterprises helped to give buoyancy to the economy. Although the small-scale agricultural units showed less expansion, the overall economy surged forward carrying per capita incomes to the highest among African nations south of the Sahara.

During 1964-1974 the growth of the Kenya economy was impressive: real GDP at factor costs rose at an average annual rate of 6.2% and even higher in later years. The growth rate, however, has slackened in recent years, with an actual decline from 1979 to 1980 in real income per capita for the first time on record. Several factors contributed to this, including adverse weather effects on agriculture in 1979 and 1980. Foreign markets for Kenyan products weakened, while net costs of energy and import costs for manufactured goods increased. Trade opportunities lessened with the closure of the border with Tanzania (cutting off an expanding market to other countries as well) and the difficult internal situation affecting the Ugandan economy. Domestic fixed capital formation has declined substantially in many lines with exhaustion of the multiplier effects of the 1976-77 "coffee boom" and expansion of Nairobi as a regional center for both international and private organizations. Moreover, the pattern of imports which evolved following the 1976-77 prosperity has been found difficult to readjust. Consequently, net trade balance, compounded by heavy food imports, has continued to record high deficits. Internally there has been large borrowing from the Central Bank despite continued inflows of developmental resources. The inflation rate has accelerated to 12% to 15%.

Kenya faces a difficult future. The growing population -- now reported to be increasing at a rate of 4% per year -- is being provided with wider educational opportunities, but these are inadequate relative

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to the demands of the economy and available candidates. Even more important, skills are not being developed to give the nation comparative advantages in particular lines. The falling rate of fixed capital formation has ominous implications. Agriculture -- which provides the bulk of employment, 80% of foreign exchange, and over one third of GDP -- accounted for less than 10% of fixed capital formation in 1980 after a decline of 40% from 1977 to 1978 levels. The economy will need to be strengthened and adjusted to meet the challenges for increased productivity in agriculture required to cope with the world economic order of this decade and the rest of the century.

3.2 Kenya's Development Plan 1979-1983

The Fourth National Development Plan (1979-1983) focuses on efforts intended to "improve the well-being of the people of Kenya." The objectives, policies, and programs emphasize continued economic growth, the creation of more income-earning opportunities, increase in the output and quality of services, and improved income distribution throughout the nation. For a nation that is predominantly agricultural and a population that is 85% rural, this means a strategy for rural development aimed at increasing productivity in agricultural and rural employment and increases in total agricultural output.

The Fourth Plan, which can be described as a "growth and equity" plan, sets out to achieve an overall annual economic growth of 6.3%, despite constraints of balance of payments, inadequate government revenue to finance expenditure, and inadequate national savings. This projected growth rate, although comparable to rates attained in the decades of the sixties and seventies, is considered ambitious in the present circumstances. It is proposed that agriculture accord high priority to the development of medium- and low-potential arid and semi-arid areas of production and to the promotion of agricultural exports. Efforts would also continue in the direction of improving the productivity of the high-potential areas for food and export crop and animal production.

The plan's basic objectives of freedom, opportunity, equality, social justice, and equity are to be pursued on the basis of four principles that are considered fundamental to the development process. These are:

- * Widespread participation in the development process;
- * Diversity of organizational forms and incentives in advancing the economic and social objectives of development;
- * Government participation in initiating and directing development with the highest standards of efficiency;
- * Mutual social responsibility through promotion and regulation of economic activities.

These principles envisage the increasing control of the nation's resources by Kenyans; they emphasize the need to re-examine the functions of various institutions within the economy. This is to ensure their orientation to national and domestic interests such as small farmers in rural areas, domestic investment, and increased productivity for small-holders. The plan would place greater emphasis on the transformation of the nation's institutions to serve the specific needs of all Kenyans.

Previous development plans in Kenya have made substantial progress in building the technological, infrastructural, and administrative base for

the development of agriculture and industry. While recognizing the presence of second generation problems and current constraints and opportunities in development, it is believed that a take-off position for the development of agriculture has been reached. The more difficult task of finding and implementing effective ways of promoting rural development is now recognized as urgent, and the plan presents a basic strategy for meeting this and other challenges of agricultural development in the rest of the country.

The basic strategy for development, according to the plan, is the alleviation of poverty throughout the nation, especially in the group of families engaged in smallholder agriculture. This group constitutes about 80% of Kenya's total population and feature incomes of about KE 100 to 150 per family per year including subsistence production.* Several dimensions of poverty are recognized, including malnutrition, inadequate standards of living, and inefficient expenditure patterns (many of these dimensions are considered both extensive and pervasive). The objective of alleviating poverty is being pursued through (a) the creation of income-earning opportunities; (b) the improvement of expenditure patterns; (c) the provision of basic needs such as nutrition, health care, basic education, water, and housing; and (d) institution building. The greatest weight will be given to the creation of income-earning opportunities through mutually supporting development efforts featuring capacity utilization, employment creation, and rural development. It is envisaged that the majority of the rapidly growing younger population would find employment and self-employment in rural areas, with emphasis on small-scale agriculture, development of arid and semi-arid lands, integrated industries, and other rural non-farm activities. Research and development institutions are to be encouraged and provided with resources to address themselves effectively to the transfer, adaptation, and development of specific technologies for rural areas.

The policy framework of the plan presents instruments by which the government would translate the development strategy into programs, plans, and achievements during the period. This framework provides for flexibility and possible modification as development proceeds. The detailed projects and programs focus on the central theme of alleviation of poverty in its several dimensions, with emphasis on income, consumption, and nutrition. Using the criteria of low incomes and lack of access to opportunities, target groups are identified for the plan. Three are specifically agricultural:

- Pastoralists -- those whose income is derived mainly from the care of livestock in a nomadic setting;
- Small farmers -- those with land who derive the majority (but usually not all) of their incomes from working the land;
- Landless rural workers -- those who have little or no land and who derive the majority or all their income from casual farm employment and nonfarm rural activities;

Other target groups include:

- Urban poor -- those who live in poverty in urban areas with limited incomes derived from casual self- or wage-employment;
- The handicapped -- those who must be given skills commensurate with their abilities and the opportunities to use those skills productively.

* Integrated Rural Survey 1977

Several programs are expected to improve prospects for development of these target groups and to increase their opportunities for constructive participation. These include: the Integrated Agricultural Development Program (IADP); Cooperatives Development; expansion of social and education facilities; and improvement of opportunities for rural non-farm activities. Other policies on tariffs and pricing, employment and incomes, rural development, land reforms, science and technology, environmental management, population, fiscal and monetary, and public and private institutional development are to reinforce the overall strategy for social and economic development in the period 1979-1983.

The expected growth emanating from these objectives, strategy, policies, and programs is presented in Table 3.1 (annual rates of change), 3.2 (GDP by industrial origin), 3.3 (projected 1983 modern sector employment), and 3.6 (GDP: actual 1976; projected 1983) of the plan.* The estimates and forecast of total value of selected agricultural commodities and the average annual rates of growth are shown in Annex 6a. Present progress towards these targets should result in substantial economic growth, improved agricultural productivity, significant changes in the structure of the economy, wider distribution of benefits, and continuing improvement in the quality of life.

3.3 Primary Production: Agriculture and Natural Resources

The plan recognizes primary production as the mainspring of development. Eighty-five percent of the population is dependent on primary production, and about 50% of the nation's export earnings come from primary products. Agriculture is the key to the plan's objectives, and the policies and strategies for agricultural and other natural resources production envisage substantial investment and increased productivity and output. The programs for agricultural development are based in ministries of Agriculture, Natural Resources, Livestock Development, Tourism, and Wildlife (fisheries department), Land and Settlement, and Cooperative Development. The first four are the key ministries, and the last two provide technical and organizational support. The ministries of agriculture and livestock department, which are the main organs for the development of primary production, feature development expenditures that are expected to grow faster than those of other ministries, with the rate to increase nearly two-fold in the last year of the plan period, representing 23.6% of the total development expenditure compared to 12.6% in the first year.

Agriculture is to provide the main thrust toward the major objective of alleviation of poverty. Development is to be obtained through more rural employment, higher rural incomes, and improved diet. The focus will be on the full utilization of the resources of land and labor, greater productivity of agriculture in the high-potential areas, and increased use of medium- and lower-potential areas. In order to improve upon the performance of Kenya's agriculture in terms of output, which doubled in the last 20 years, and to contain the problems of growth that threaten social and economic progress, five major interrelated objectives are defined for the agricultural development plan as follows:

1. Poverty alleviation -- through the provision of income-earning opportunities in agriculture;

* Development Plan 1979-1983, Part I.

2. Agricultural growth -- through major changes in output trends and increased productivity;
3. Improvement of balance of payments -- through increased production of basic food needs without imports and without inhibiting export production;
4. Employment -- by absorbing increasing population in agriculture as the major productive activity in rural areas;
5. Conservation of natural resources -- through the planned exploitation and management of soil and other natural resources, soil erosion control, and protection of forests and watersheds.

A number of constraints are identified, including scarcity of natural resources, product prices (domestic and export), appropriate technology for smallholder farming, investment in agricultural research, implementation capacity, and other financial constraints. It is noted that the "technology constraint" will be more severe during the current development plan period and that research breakthroughs or technological innovations adaptable to smallholder farming are not available for immediate adoption. However, the targets will have to be based on the wider application of known technologies, such as hybrid and early-maturing maize varieties and dairying techniques, and on the improved technologies anticipated from a substantial increase in agricultural research investment.

To achieve high rates of performance in contexts of the objectives and identified constraints, the plan will focus on seven major related elements:

1. More intensive land use and development -- to meet the increasing requirements for raw materials and export commodities;
2. Development of appropriate technologies -- through agricultural research to develop technologies for land-use intensification in smallholdings, including mixed farming, and agricultural production in low- and marginal-potential areas;
3. Smallholder development -- through developing the production potential of smallholder farming to which research and extension services will be oriented;
4. Arid and semi-arid land development -- to assist sedentary and pastoral populations to increase their output and incomes;
5. A poverty alleviation focus -- through agricultural development programs that will use appropriate technologies to generate maximum employment for small farmers and improve the economic welfare of the rural poor;
6. Market incentives -- to trigger changes in the quantity and composition of agricultural output and to improve marketing efficiency and price margins available to farmers;
7. Increased access to land and land-based employment -- through a reassessment of land tenure and full production utilization of parts of large- and small-scale farms in high- and medium-potential areas; also the expansion of labor-intensive or alternative agricultural production activities and IADPs.

The targets of the plan, established after assessment of Kenya's national objectives, constraints and resources, focus on:

Agricultural production -- with a planned (1978-83) monetary production growth rate of 6.3%, non-monetary production of 3%, and a weighted total growth rate of 4.7%;

2. Agricultural income -- with a steady increase in incomes of the agricultural population based on a projected 2.1% annual per capita agricultural production;
3. Balance of payments -- through the contribution of agriculture to exports, raw materials for exported manufactured goods, and by import substitution;
4. Agricultural employment -- through a planned increase of on-farm employment at the rate of 2.7% per annum resulting from increased public expenditure in soil and water conservation, expansion of area of labor-demanding crops, and general improvement of rural employment;
5. Food and nutrition -- through increasing output of food for domestic consumption at a higher rate than population increase, ensuring increases in per capita food intake and overall nutritional status;
6. Expenditure -- through a substantial increase for the Ministry of Agriculture (including livestock development) from KE 102.4 million in 1982-83 -- a 118% growth of expenditure over the period.

The plan also envisages a Program of Action directed at Kenya's 1.7 million farm holdings to achieve more productive farming through the effective use of the resources of land, labor, and capital:

1. Incentives and regulations in relation to price, land, labor, and research and technology policies;
2. Provision of agricultural services such as knowledge, inputs, credit, and market for agricultural production and development;
3. Implementation of specific programs and projects as given in The Kenya Fourth Development Plan - 1979-1983 (Part I, pp. 246-259). Projected increases in output of food crops, industrial crops, export crops, and livestock products are also documented in the plan (pp. 259-266). The programs and projects are expected to be supported by Services for Agricultural Development classified under: Agricultural Research; Agricultural Education and Training; Agricultural Extension and Information; Crop Development and Farm Management; Livestock Development; and Agricultural Credit. Details are set out in the plan document (pp. 236-246).

3.4 Livestock Production Plan

The livestock development policy of Kenya, with the necessary research inputs and support, is detailed in the "National Livestock Development Policy" paper of June 1980, produced by the Ministry of Livestock Development as a guide for the decade. The document analyzes present and projected production trends in relation to demand and indicates large and continuing deficits in meat and milk. The policy objectives were defined as: increased production to avoid importation of animal products and provide for improved human nutrition; increased production of feeds and fodder to support the animal production industry; the creation of income-earning opportunities at all stages of animal production and marketing; improvement in the productivity of land in the high-potential areas; and full development of the extensive rangelands in the medium- and marginal-potential areas. The achievement of these objectives is necessary to meet the high rate of increase in human population and demand for animal products, recurrent incidence of drought and other favorable weather conditions, high incidence of animal disease,

high costs of feeds, drugs, and water, and unsatisfactory infrastructure support for animal production in the rangelands.

The objectives of the plan and the present constraints suggest pursuit of strategies that would encourage efficiency in animal production, processing, and marketing. This is expected to lead to an expanding livestock industry that requires less intervention from the government -- which could then concentrate on the provision of infrastructure, research support, public services, and incentives. With adequate research support, it is proposed to implement various programs of expansion and intensification of livestock production, disease prevention and control, animal nutrition and management, and improved distribution and marketing. Emphasis will be placed on the following classes of livestock: cattle, sheep, goats, pigs, poultry, rabbits, camels, and bees. Special research is envisaged covering the potential of camels to contribute to internal and external trade in meat, milk, and wool and the expansion of the current sheep and goat production projects. Research on improving the productivity of livestock will feature breeding and upgrading of the Zebu cattle, progeny testing, feeding, and management, the prevention and control of reproductive diseases, and improved beekeeping. The research strategy will be supported by measures of vector and disease control and management, the testing of alternative trypanocides and other drugs in areas of drug resistance, and the documentation of disease situations in arid and semi-arid areas as well as in wildlife-livestock complexes. The emphasis will be on preventive medicine, and complementary measures will be assured through cooperation and coordination with other ministries and parastatals in respect to water supply, land use, marketing, credit, and external trade in relation to livestock production.

There will also be a strong emphasis on research into whole-farm systems involving livestock. This represents a multidisciplinary approach for the development of crop and animal technologies suitable for the medium-potential and marginal farming areas and smallholders, as distinct from large-farm situations in the high-potential areas. The Ministry of Livestock Development is expected to play a major role as coordinator so that all policies and programs are brought into national focus to avoid the duplication of efforts and reduced effectiveness in the utilization of manpower and other resources. The Ministry of Livestock Development is actively pursuing cooperation with:

- * The Ministry of Agriculture (e.g., in fodder and feed production);
- * The Ministry of Water Development (e.g., in ranching and stock water development);
- * The Department of Land Settlement and Adjudication (e.g., in finance);
- * The Ministry of Transport and Communications and the Ministry of Works (e.g., in rural infrastructure);
- * The Ministry of Environment and Natural Resources (e.g., in fisheries and protection of water catchment areas);
- * The Directorate of Personnel Management (e.g., in livestock ministry personnel matters).

Close interaction of research and development in livestock production has potential for creating and sustaining a viable livestock industry capable of meeting Kenya's needs for food, nutrition, and export. The

entire plan provides for integrated policies, services, and programs covering broad areas of technology, prices, markets, land, labor, resources development and utilization, and nutrition as the basic framework for agricultural development in the period 1979-83 and in the years ahead.

3.5 Kenya's Long-Range Development of Agriculture

Kenya faces a formidable challenge to provide sufficient food for one of the fastest growing populations of the world. The current growth rate is reported to be in the area of 4% per annum. With half of the population below the age of 15 years, there will probably be acceleration of this rate in the next two decades unless steps are taken to introduce population control measures. The supply requirement is made more difficult by the much higher growth rate of urban areas, where incomes are increasing more rapidly and where food demand increases will be even larger. The growth rate in food demand, implied by the natural population growth alone, exceeds the rate of growth in agricultural output of the fastest growing agricultural economies of the world. Kenya has relatively limited amounts of well-endowed lands to bring into production to meet these needs. One choice in policy is between intensifying use of present cropping areas and shifting land now used to support livestock to the production of primary products for direct human consumption. Some increase in national output can be achieved through development of arid lands, but this would probably require more inputs per output unit than would intensification in the better endowed areas.

There seems to be little room to maneuver by altering foreign trade in foods. In the years 1975-79, exports of food and beverages (less coffee and tea) averaged K£ 36 million per year; the average value of food imported was K£ 28 million per year.

A 4% growth rate in population would carry the total population to 18.3 million by 1983, 12% above 1980 and 28% above 1976 (year of a record maize crop) when population was 13.8 million. By the end of the 1980s the population would expand by nearly another 5 million persons, 42% over 1980 -- 67% above 1976. These population increases can be translated into food demand increase given assumptions about increases in per capita disposable incomes, income elasticities, and (unlikely) constant relative prices. The calculations are shown in Table 3.1.

Table 3.1 Projections of increases in food demand to 1983 and 1989.*

	Production required for self-sufficiency			increase over 1980	
	Actual/Output			%	
	000 ton				
	1980	1983	1989	1983	1989
Maize	2,153	2,777	3,514	29	63
Wheat flour	142	292	493	106	247
Sorghum & Millet	369	445	563	21	52
Rice	23	66	90	187	291
Beans	140	253	344	81	146
Potatoes	450	655	823	46	66
Beef	147	188	314	28	114

*From Kenya Development Plan, 1979-83, Ministry of Agriculture, June 1978. As the production of maize in 1980 was adversely affected by the weather, an average of 1976 and 1980 production levels was used as the base for the 1980s.

The items in Table 3.1 accounted for a little over 60% of per capita calorie consumption in 1980. Only sugar would be in excess of demand in 1983 and 1989, assuming continuation of present policies. For other products the increases needed ranged from that equal to population gains to several hundred percent for wheat and barley. Two emphases seem necessary in long-range development: (a) increasing the productivity of the high-potential areas through intensification and consistent application of appropriate improved technologies (b) expanding and strengthening production in the medium- and marginal-potential areas. The latter strategy will require research-generated improved technologies for turning these medium and marginal areas into productive areas, mainly under smallholder farming conditions.

Reliable and current statistics on livestock numbers in Kenya are not readily available. The last countrywide livestock surveys were carried out in the mid-sixties. A livestock census was expected to be carried out in 1981. Planning has been based on estimates and projections. (The contribution of Kenya Range Ecological Monitoring Units (KREMU) to these estimates has tended to exclude the high-potential areas.) The estimates currently in use are shown in Table 3.2.

Table 3.2. Estimates on Livestock Population, 1979 (000 Head)

	Improved	Unimproved	Total
Cattle	1,127 (dairy) 600 (beef)	8,460	10,247
Sheep	500 (wool)	6,000 (hair)	6,500
Goats	2 (dairy)	8,500 (meat)	8,502
Poultry	1,760 (exotic)	15,020 (indigenous)	16,780
Pigs			70
Rabbit			34
Camel			607
Donkey			135

Source: Animal Production Branch, Annual Report 1978.

In 1975 it was estimated that there were some 50.4 million ha available for grazing. Considering the different carrying capacities of the ecological zones, this would have meant a support potential for 12 million livestock units, not allowing for other forms of land use (e.g., wildlife). About 6 million livestock units were considered a realistic estimate for 1975. Increasing cultivation and other forms of land use will bring a grazing land availability decline of 3% to about 48.8 million ha by 1990, but its carrying capacity will go down by 14% to about 10 million units as the withdrawal of land from grazing takes place mainly in the high-potential areas (Table 3.3).

Table 3.3 Land available for grazing and carrying capacity per zone, 1975 and 1990.

ZONE	1975 Million ha	livestock units	1990 Million ha	livestock units
II High potential	2.0	3.8	1.6	3.0
III Potential	4.0	4.0	3.0	3.0
IV Semi-arid	5.4	1.4	5.2	1.4
V Arid	26.2	2.2	26.0	2.2
VI Arid	13.0	0.4	13.0	0.4
Total	50.4	11.8	48.8	10.0

Considering the productivity of the high-potential land lost to grazing, the livestock decrease expected may be as much as 20% unless effective subject-related research and considerable increase in managerial skills are achieved at all levels. Against this probable decrease in total livestock units is the forecast of a human population of more than 25 million in 1990, compared to the present 16 million.

The policy document of the Ministry of Livestock Development notes that past public policy at times has constrained the development of the livestock industry. It recognizes the need for sound planning, implementation, monitoring, and evaluation of projects so that full advantage can be taken of funds and other resources made available for livestock development. Attempts will be made to remove institutional barriers and promote decentralization with greater involvement of field staff. The ministry also shows awareness of the long-term character of projects in livestock production and of the fact that many projects which appear to be non-viable at present may be justified on the basis of higher potential productivity in the future.

To prevent the projected deficit in production, the carrying capacity of the remaining land will have to be increased through intensive land use and production systems. This would involve:

- * Research aimed at producing packages of livestock production technology suitable for small-holdings;
- * Improved extension of existing knowledge and closer liaison between research and farmers.

Contributions of the Ministry of Livestock Development to the development of arid and semi-arid areas will continue within the framework of the Kenya Livestock Development Project (Phase II and III) with the aim of achieving a gradual buildup of ranch and grazing block improvements rather than large capital investments. The primary objectives will be to ensure self-sufficiency and to develop marketable surpluses. Water development is seen as a means to increase productivity by reducing long treks to water, and three stages of water development are envisaged in the plans towards intensification.

Another long-term strategy to reduce the pastoralists' dependence on milk and other livestock production involves control of overstocking, making available alternative food items, making arrangements for marketing facilities, and providing adequate price incentives. It is hoped that a combination of these methods will lead to increasing off-takes per annum from herds and flocks, as estimated in Table 3.4 (see next page).

The Ministry of Livestock Development opinion is that the low off-take rates of the pastoralists can be considerably improved in the long run; it provides a package of measures which still require strong research inputs in areas of animal diseases, breeding, agrometeorology, socio-economics, marketing, etc., and for monitoring of the effects of proposed improvement measures. The further improvement of off-take figures on large-scale farms can be achieved in the long run if marketing and other applied biological constraints can be removed. The envisaged off-take increases in small holders herds through the rearing of male dairy calves will also be a long-term venture with heavy demands on extension and services.

Table 3.4 Estimated off-take rate by species per annum in percent of total herds or flocks.

Species/Type	Off-take as % of herd/flock	Farming Areas
Cattle: Grade Dairy	20%	Mixed farming, large scale
Grade Beef	25	Mixed farming, large scale
Grade Dairy	18	Mixed farming, small holding
Zebu crosses	15	Mixed farming, small holding
Zebu	13	Mixed farming, small holding
Zebu crosses	25	Commercial ranches
Zebu	10	Pastoral areas
Goats	25-35	Lowest Central Prov. Highest Eastern Prov. and Nyanza Prov.
Sheep	17-30	Lowest North East Prov., Highest RV. Prov., Coast Prov. and Eastern Prov.

Source: Animal Production Branch, Annual Report 1978

Sheep and goat development through ranching schemes has short-term possibilities plus the ability to contribute towards long-term requirements for meat and milk. Sheep and goats are highly adaptable and complementary to cattle in their resource requirements, and their inclusion into ranches should achieve greater efficiency in the utilization of ranch resources. Some research undertaken since the early seventies, and on-going work on sheep and goats, provide a basis for implementation of such programs.

The camel development project is in its early stage. It would require long-term, multidisciplinary field research strategy and inputs.

Beside its commitment to necessary short-term programs and projects, the Ministry of Livestock Development envisages long-term plans for the realization of the potential of dairy cattle. Productivity in excess of 2,000 kg per lactation has been shown to be possible, but present productivity varies from 150 kg per year from Zebu cows in the high-potential small-holdings to 850 kg for grade dairy cows under similar conditions. The gradual shift towards zero grazing, particularly in the densely populated high-potential areas, has already been initiated, and a range of measures is available on the basis of earlier research work. Success will depend on satisfactory pricing policies and on more effective coordination of technical measures. Socio-economic studies will have to guide the approach to the small farmer, and adequate extension and continuous monitoring will have to provide the feedback to research to ensure the effective impact of research on long-range livestock production and development.

3.6 Research for Agricultural Development

Kenya's development plans have been drawn up to support the needs for increasing agricultural production to achieve national goals. Accelerated agricultural production will need more development in additional infrastructure: roads, water supply, etc.; improving supplies of seed, fertilizer, chemicals, equipment, etc.; and reinforcing agencies which provide extension, training, credit, marketing, etc. Much of the planning tends to assure that further development would be brought about by applying more resources to various elements of the production

process using existing production functions. However, it has been demonstrated frequently in the past that increased production can also be achieved by increasing the efficiency of elements of the production process -- through better seed, better understanding of timing and quantity of fertilizer, better ways of managing calves, etc.

An essential role of the agricultural research system is to improve the efficiency of use of the development resources, contributing to an increase in productivity and to an improvement in the income of the farmer. An end product of the agricultural research system should be the formulation of feasible agricultural development projects for consideration by the central planning authority. The route from research to development process and project should always be reasonably clear, whether it is basic or survey research to generate necessary knowledge in agricultural sciences (e.g., genetic theory, collection of germplasm, developing inventory of national resources); applied research to generate new technology (e.g., breeding techniques); technological research fitting technologies together into a practicable innovation (e.g., a new variety with desirable characteristics); or the testing of an innovation in a specific setting and adapting it to the local environment of socio-economic conditions. All stages are necessary in the national agricultural research system, but some facets will require more emphasis (and resources) than others. It is more efficient to use directly as much of the world's stock of knowledge and technology as possible; this permits the focus of scarce resources onto those aspects that can only be done in Kenya. All research stages require creative thought and imaginative interpretation and will need an environment that fosters creative activity.

The place of the agricultural research system in contributing to the establishment of the national agricultural development plan is illustrated in Fig. 3. Most project planning is done on the basis of well-established world knowledge supplemented by critical, recently acquired information from experiment or survey. A major task of the agricultural research establishment is keeping abreast of world knowledge (including Kenya's contributions) and interpreting it in the light of Kenya's needs, resources, and constraints; new advances can then be exploited rapidly in terms of better development plans. Each year more information will be generated from the national agricultural research stations, but the increment will be small in relation to the accumulated body of knowledge. It is important for efficiency in research development that these small contributions are focused on critical gaps in the areas of knowledge and understanding. Contributions will be necessary (a) in terms of better descriptions of the inventory of resources and constraints as well as (b) in the development of new technologies to exploit the resources to the utmost and to overcome the constraints. The range of the inventory is wide, including physical and biological resources, human capacities, institutional structures, and the state of infrastructure and socio-economic environment. Priorities for research must be carefully assessed and assigned. Progress is an iterative process in which agricultural development projects are planned on existing knowledge, accepted in the framework of the national plan, implemented, and monitored. The imperfections that emerge point to the need for better planning information and to specific demands for further research to produce better projects. The scope and efficiency of a research system is reflected in the number and degree of reliability of possible agricultural development projects for investment.

The research system itself is made of people, facilities, and institutions. It can again be represented by a cyclical process as shown in Fig. 4:

1. The requirements of the national agricultural development plan -- incorporating national policies and objectives -- identify high priority topics for research;
2. Research programs are formulated to generate new information needed;
3. The manpower needed for research programs is determined and given special training if necessary;
4. Suitable research stations or other institutional arrangements and facilities are provided to enable the research capacity to be operated effectively;
5. Research results are assessed, communicated to all likely users in appropriate form, interpreted in relation to previous knowledge, and incorporated into new and better agricultural development project proposals.

There are many reinforcing feedback loops. More manpower with better training can identify problems more precisely; with better facilities it is possible to plan better research programs, etc.

Much of the benefit of research comes from steady improvement in the capability to plan profitable development projects more reliably with better technological tools. There are many conspicuous examples in Kenya of the value of research contributions to increased production and income, such as the introduction of better clonal material in tea, better management and better fodder grasses for dairy production, effective vaccines for diseases, etc. (The example cited in the Sessional Paper No. 4 of 1981 on national food policy is the increase in production of maize made possible by research into the creation of the higher yielding hybrids and composites. The average yield of maize has risen from about 1 t/ha in 1963 to about 1.75 t/ha in 1980. The yield of a good farmer may be about 6 t/ha, and some do even better. There is a large gap between 1.75 and 6 t/ha, which points to further substantial benefit from imaginative and creative research and from correct and consistent application of improved technologies available).

The National Development Plan has pointed out how the pattern of agricultural production has moved from large-scale farming systems to small-scale systems and how more marginal areas must be brought into increased production. The earlier research and development workers were aiming at the high-potential areas under large-scale farming; they were able to draw on a great world wealth of relevant technology that could be applied with relatively little modification. There is much less world knowledge available for production systems for small farmers or on how to get new information to large numbers of low-capital farms. There is now a greater need to carry out more research within the country to generate information for reliable development projects, as well as to keep in close touch with the small amounts of new information emerging from other countries which are also grappling with the same problem of increasing productivity from small-farmer systems. Much basic information on agricultural sciences is being generated in the developed countries, but technologies and innovative practices evolved in such countries are geared to larger farm systems; considerable reassessment and interpretation is needed before suitable new practices can be developed for smaller farmers.

Demands for increased agricultural production from small farmer production systems on lower-potential land will require greater intensity of local research to evolve improved technologies for better productivity.

CHAPTER 4 ORGANIZATION OF AGRICULTURAL RESEARCH IN KENYA

4.1 Background and Historical Development

The system of agricultural research in Kenya dates to the beginning of this century. Research services have mainly been developed and advanced in response to needs as viewed by the government and the farming community. Agricultural research has been given a development focus from the outset. Most of the activities have been in the applied sciences with strong emphasis on the improvement of the quantity and quality of agricultural products.

A number of research institutions were established early in this century: Forest Department (1902); Scott (now National) Agricultural Laboratories (1903); Coffee Research Services (1908); Veterinary Research Laboratories at Kabete (1910); and the Plant Breeding Station at Njoro (1927). The most extensive development of agricultural research stations occurred in the 1940s and early 1950s, when a number of national and regional agricultural research stations were established under the Department of Agriculture.

In the same period were created several research establishments under the East African High Commission (subsequently East African Common Services Organization and East African Community). Those in agriculture were the East African Agricultural and Forestry Research Organization (EAAFRO), the East African Veterinary Research Organization (EAVRO), the East African Trypanosomiasis Research Organization (EATRO), and the Tropical Pesticides Research Institute (TPRI). The EAAFRO took over staff, facilities, and the library of the research station at Amani, Tanganyika, founded before 1914 by the German administration and revitalized by the British in the 1920s. These regional research establishments concentrated on problems and sciences common to the three East African countries. The national establishments were to concentrate on national and local problems and development-oriented research.

Other research establishments related to food and land use were institutionalized later. Although the Game Department (which included fisheries until 1957) and the National Parks had been established in the mid-1940s, government support for research on wildlife did not really develop until the 1960s; most earlier research was externally supported. Research in marine and fresh water fisheries was also institutionalized at the East African Community level.

The earliest of the East African institutions, the East African Meteorological Department, was established in 1929. Climatic data emanating from this institution contributed significantly to the agricultural research and development programs in Kenya.

Although some further development of government research establishments did not take place until the 1960s, the emphasis on applied sciences for development had earlier begun to create a wider policy for indigenous training and new research facilities. Training of agricultural scientists at the higher education level within East Africa began at Makerere College, Kampala, which later became the main campus of the University of East Africa, and which had its faculty of veterinary

medicine in Kabete, Kenya. Following independence and the recognition of the need for increased output of agricultural scientists, the University of Nairobi, with faculties of agriculture and veterinary medicine, was formally established in 1970. Social sciences were introduced into the university more recently, the major development being the establishment of the Institute of Development Studies (IDS) in 1965.

An agricultural school, which later became famous throughout East Africa for training agricultural technical personnel, was established in 1939. It was upgraded in 1952 as Egerton College to train at the full technical diploma level. The training of laboratory technicians and technologists was facilitated later through the establishment of the Kenya Polytechnic in 1961 and the Mombasa Polytechnic in 1974.

Complementary to this development in research and training was the growing investment of the government in scientific and technical information and extension services. Schools for the training of field extension agents were established at the Embu and Bukura Institutes of Agriculture and at the Animal Health and Industry Training Institute (AHITI) at Kabete. The Agricultural Information Centre (AIC) and the Kenya Documentation Centre (KADOC) were also established for the communication and dissemination of information.

4.2 National Council for Science and Technology (NCST)

When Kenya attained independence in 1963, the government foresaw the need for a machinery for making and implementing policy for science, technology, and research in all sectors of the economy. Responsibilities for research policy and management lay with government departments, but little coordination existed between the agencies. (For example, veterinary research in the department of veterinary services was for many years not effectively linked to research in animal production in the department of agriculture, although the two departments were in the same ministry.) In addition, the government felt that the rising expenditures in the technical departments of ministries called for a review mechanism to ensure rational utilization of the available resources.

Debate on the type of institutional arrangement required for the formulation of science policy started in 1965, involving the government ministries (principally finance, agriculture, health, economic planning, education, and natural resources and wildlife), the University of Nairobi, and the East African Academy. The suggested type of institution was referred to as "National Science Council," "National Research Council," and "National Science and Research Council." The issue was deadlocked for some time.

The Ministry of Agriculture put forward proposals for the establishment of an "Agricultural Advisory Research Council." With the uncertainty regarding the research coordination role of the proposed "National Science Council," the Ministry of Agriculture was requested to delay implementation of its proposals on the basis that there was no need for two research councils. However, the Ministry of Agriculture proceeded to establish the Agricultural Research Advisory Council, which held its first (and only) meeting in September 1969. The Council was established to:

1. Advise the Minister for Agriculture as to problems that require research attention;

2. Evaluate progress on current investigations;
3. Identify means to strengthen and expand the agricultural research program.

The council addressed itself to all these topics and made recommendations. One recommendation was that the ministry be reorganized into four major technical service activities, namely: (a) development; (b) research; (c) extension and education; and (d) regulatory services.

In the council's view, the above structure would accord research services greater prominence and sharpen the focus of research. The report of the council noted that the representatives of veterinary services, while agreeing in principle to the four-part division of the ministry's functions, had reservations about the wisdom of separating veterinary research from veterinary regulatory services.

The government proceeded with plans for the establishment of a national machinery for the formulation and implementation of the national science policy. Through an Act of Parliament, the Science and Technology Act of 1977, the government established a mechanism for advising on "...all matters relating to scientific and technological activities and research necessary for the proper development of the Republic; and for the coordination of research and experimental development; and for matters incidental thereto and connected therewith." The Act was amended in 1979 to facilitate the establishment of statutory research institutes. At present the machinery comprises:

1. The National Council for Science and Technology (NCST);
2. The Advisory Research Committees (ARCs);
3. The Statutory Research Institutes (SRIs).

The details of the responsibilities, functions, and relationships of these organizations are shown in Annex 8.

A basic objective of the Science and Technology Act is the promotion and coordination of research in the country. The organization established is designed to fulfil three basic functions, namely: (a) policy and strategy (by NCST); (b) management and tactics (by ARCs); and (c) execution and operations (by SRIs).

The system has been designed to establish a series of circuits which involve socio-economics and the utilization of research results for development, providing linkage between policy makers and operational research establishments.

NCST establishes policies and strategies through the interaction of scientists and policy makers who focus on the use of science and technology for development. The management and tactics level involves promotion, sponsorship, and coordination of research. This is the responsibility of the Agricultural Sciences Advisory Research Committee (ASARC), whose membership reflects disciplines relevant to national programs of research needs and priorities. Cross membership with NCST and ARCs ensure active cooperation. The execution and operations level involves the carrying out of projects of scientific research by research institutions.

Although ASARC was established in 1979, it is not fully functional because of lack of personnel in its secretariat.

The Kenya Agricultural Research Institute (KARI) and the Kenya Trypanosomiasis Research Institute (KETRI) were established in 1979 to undertake research activities formerly carried out by the East African Community research institutions and also to take responsibilities for agricultural research undertaken by government departments. The latter objective has not been fully realized by KARI; KETRI is getting established and making progress.

In spite of the efforts of the last 4 to 5 years to establish an institutional framework for agricultural research, there has not yet emerged a functional, comprehensive, and cohesive organization with responsibilities for the planning, coordination, execution, and supervision of agricultural research programs. Responsibilities for the planning, coordination, and execution of agricultural research appear to be diffuse; many departments, agencies, boards, and units are involved in part or all of these processes with little effective coordination and optimization of available resources. Among the main establishments involved in agricultural research at present are the Scientific Research Division (SRD) of the Ministry of Agriculture, with its network of national and regional research stations and laboratories; the Ministry of Livestock Development; the Kenya Agricultural Research Institute; the Pyrethrum Board; the Coffee Research Foundation; the Tea Research Foundation; and the National Irrigation Board. In addition, the University of Nairobi, especially the faculties of agriculture and veterinary medicine, is involved in research programs through several ministries and direct grants for problem-oriented agricultural research. The present system is summarized in Fig. 5 (this excludes some research and development organized in the private sectors). The organization of research in the major elements of the present system is discussed below:

4.3 Ministry of Agriculture

Research in the Ministry of Agriculture is managed by the director of research, who is responsible to the director of agriculture for the organization and management of all research activities and stations. The SRD, located in the ministry headquarters, provides the central management secretariat; it is responsible for ensuring the compilation and coordination of the research budget and the defense of these estimates. Although a number of research programs are specifically identified in the estimates, the main recurrent budget for research is amalgamated under one subhead, and the director of research has authority to distribute these funds, either wholly or partially, in accordance with the original estimates.

The Directorate of Research has an establishment for two senior scientists to assist the director with administrative functions and evaluation and coordination of research programs at the station level. The directorate is also responsible for technical aspects of negotiations on technical assistance projects and the distribution of manpower among research stations. There are three major categories of research stations under the SRD. The National Research Stations (NRS) are the largest and have countrywide responsibility for major agricultural crops like maize, wheat, sugarcane, horticulture, and integrated agricultural research activities (e.g., dryland farming or specialized services like soil analysis and crop protection). Regional Research Stations (RRS) are responsible for research specific to the region concerned. These stations cooperate with the NRS to ensure wider testing of new genetic

materials or agronomic practices. The third category comprises small sub-stations, or test sites, which are selected and operated by national or regional stations. These sub-stations provide facilities for controlled experiments in various sub-ecological zones and for the organization and supervision of pre-extension trials on farmers' fields.

Each station is headed by a scientist at the level of either director or officer-in-charge, depending on the size and responsibility of the station. These officers are responsible for the management of station resources, including personnel, allocated funds, physical plant, and (except for the occasional directives from the director of research) are expected independently to generate and execute agreed research projects. There are 6 national, 7 regional, and about 20 sub-stations and major trial sites under the SRD.

The Ministry of Agriculture is also responsible for commodity research stations for coffee and tea, but these operate under the direct management of respective commodity statutory boards as nonprofit research foundations. A similar facility exists under the National Irrigation Board but without a separate formal organization. Under the provisions of the amended Science and Technology Act of 1979, the KARI was created to operate as a semi-autonomous parastatal research institution under the Ministry of Agriculture. KARI was expected to evolve to combine the research services of the Ministry of Agriculture (including livestock development) and the Ministry of Environment and Natural Resources with those of the former East African Community to form a comprehensive agricultural research organization to serve Kenya's agricultural development. It was also expected to provide national coordination, execution, and management of research in agriculture, livestock development, and forestry. These roles have not been fully realized. Relevant observations and recommendations on these issues are made in Chapter 9.

The Ministry of Agriculture operates a number of bilateral and multilateral research projects with donor agencies, with Kenya providing counterpart personnel, facilities, and resources in areas of commodity, systems, or factor research. There are approximately 220 research officers under the SRD and about 30 in the parastatal commodity stations.

4.4 Ministry of Livestock Development

Research in the Ministry of Livestock Development is organized through the research division, which is one of four technical divisions under the Director of Livestock Development. The other divisions are animal production, veterinary, and manpower development training. Each division is headed by a deputy director. The network of livestock research stations and the discipline-oriented national research stations for animal production (Naivasha), veterinary (Kabete), and range (Kiboko) are under the deputy director for research. In addition to research carried out in this complex, the research division provides research-related services to the other divisions in the ministry and to farmers. These include veterinary investigations and quality control services for drugs, vaccines and other biologicals, animal byproducts and animal feeds. At the headquarters level, veterinary research, animal production, the veterinary investigations laboratories and quality control services are headed by assistant directors.

The deputy director for research manages the approved livestock research projects for the laboratory and field stations, with the assistance of the headquarters staff of senior research officers and general administrators. Such management involves the procurement of research resources, the monitoring of research progress directly or through a series of project administration machineries, and the preparation and publication of periodic reports and recommendations -- some of which are followed by pre-extension trials and field applications. The major constraints in the organization of research in the livestock area are the shortage of qualified livestock scientists (other than veterinarians), poor staff prospects for advancement on the basis of research productivity, and administrative bottlenecks in the advertisement of posts and the recruitment of suitably qualified staff through the government machinery.

4.5 Other Participating Ministries

Although the Ministries of Agriculture and Livestock Development are charged with the primary responsibility for agricultural research, other ministries participate in and support the agricultural research and development efforts. These include the Ministry of Environment and Natural Resources which has programs in forest resources management, wildlife, range management and fisheries, and the Ministry of Water Development. The team considers it important that agricultural research should establish and maintain close liaison with these ministries, both in terms of their inputs into the research strategy and in their demand for and utilization of relevant research results in the development and management responsibilities with which they are charged.

4.6 University and Colleges

Kenya's institutions of higher education include the University of Nairobi and the Kenyatta University College; a second university is being planned. In addition, Egerton College, Njoro, offers intermediate-level diploma programs in agriculture and related disciplines. Two other institutes of agriculture (Embu, Bukura), a school of forestry (Londiani), and three animal husbandry and industry training institutes offer training courses at the certificate level. Technical-level training takes place in the polytechnics in Nairobi and Mombasa and in other similar institutions in the country.

The University of Nairobi has faculties of agriculture and veterinary medicine. Other faculties and departments in the related sciences and social studies produce graduates who enter agricultural research. The majority of the existing corps of scientists in agricultural research obtained their first degree training in the basic sciences. The faculty of veterinary medicine (founded in 1956) is organized into six academic departments including a department of animal production, which serves both veterinary medicine and agriculture. The faculty has a staff complement of 96, 57 of whom are Kenyans. About 40% of staff time is devoted to research and the rest to teaching. A strong undergraduate program and curriculum adapted to Kenya's requirements was evolved early, and undergraduate intakes have now reached the figure of 86 per year. Postgraduate programs were introduced in 1975, and there are now about 75 postgraduate students. From 10 to 20 high quality postgraduate degree holders (mainly MSc) are produced every year; they contribute to strengthening the manpower in university teaching and in government

research institutions. The faculty contributes through the involvement of staff and postgraduate students in national research projects and through collaboration with the Ministry of Livestock Development. The major constraints include shortage of trained manpower and shortage of finance for the expansion of the undergraduate programs and the full-scale development of postgraduate training and research.

The faculty of agriculture has functioned for about 10 years and offers bachelor of science (BSc) degrees in agriculture, food science, agricultural engineering, forestry, and range management. The bulk of its output of 150 graduates per year are in the field of agriculture; this number is expected to go up to 200 a year through a World Bank project. The faculty has a total academic staff of 65, and about 50% are Kenyans. There are eight departments and 800 acres of teaching and research farms for crops and livestock husbandry. Two-year MSc programs have been introduced in agricultural economics, crop science, and soil science with intakes of 8 to 10 students into each program. The faculty graduates about 25 MSc students each year; currently about 10 students are registered in PhD programs. Research programs and priorities are determined at the departmental level, and a close relationship is maintained with the Ministry of Agriculture in cooperative research and training of postgraduate students. Agricultural research in the faculty is generally not adequately financed through university funding sources; the little thus provided is supplemented by funds for specific national research projects through the Ministry of Agriculture. In addition, some external funding (e.g., from USAID and IDRC) supports multidisciplinary research in crop protection and crop improvement and management.

The program in the department of forestry emphasizes forest resources management (community and industrial forestry), agro-forestry, the afforestation of marginal areas, and research and training to backstop fuelwood production and consumption as a priority next to food. The department has a staff of 5 (3 Kenyans). There are proposals to strengthen the program with World Bank funds and support through the Ministry of Environment and Natural Resources. The major constraint is the shortage of trained personnel for teaching and research. Despite constraints, the program has an intake of about 15 students a year and should begin to produce forestry manpower in a steady stream. Close collaboration with the forestry research department of KARI is also being developed.

The faculties have no formal channels for the delivery of research results. They depend on the traditional publications, seminars, participation in professional society activities, etc. Many members of staff serve on research advisory committees and relate personally with research activities in the relevant ministries. The faculty of veterinary medicine provides some services in animal health. Agricultural extension is taught as a subject only within the department of agricultural economics; no special research/extension liaison services are provided. There is apparent need for more efficient and regular dissemination of research findings generated from staff and staff-student research in areas relevant to national priorities.

The Egerton College, at Njoro, was founded in 1939 as a center for training farmers and potential farmers. It has become the major center for intermediate-level training in agriculture and related disciplines. Located in the heart of the high-potential farming land of the Rift

Valley, it now functions as a self-governing institution, offering 14 programs of 3-year diplomate training to an average of 225 graduates per year. These practically oriented programs range from the basic diploma in agriculture to horticulture, farm management, animal husbandry, food sciences, and agricultural engineering. The college will graduate 270 diplomates in 1981. The college is well-endowed with a staff of over 120 lecturers, a teaching farm of over 160 ha, a commercial farm of about 450 ha, well-equipped laboratories, workshops, factory, and an agricultural library. The college is destined to play an increasingly significant role in both agricultural research and development in the years ahead. It is being prepared for this role by current expansion in facilities and programs, with major assistance from USAID. It is expected that the student population will increase from the present 855 to 1,050 later this year and will have doubled next year, approximating the figure of 1,632 envisaged for 1983 in the development plan. Two new diploma programs in food and agricultural marketing and leather technology are being introduced, and a third farm for range management has been acquired (Naringo) in the range lands of semi-arid and arid Kenya. Research activities are receiving attention with the improvement in the quality of staff, and the college is collaborating with some parastatal organizations, universities, and other institutions in fields such as agronomy, animal husbandry, soil science, and agricultural engineering. Staff will be offered opportunities to undertake field thesis research in relevant areas such as dryland farming and improved technologies for smallholder farming (See Annex 9).

Apart from the major university, colleges, and institutes, other institutions -- such as the Jomo Kenyatta Institute of Agricultural Technology, the Harambee Institutes of Science and Technology, and a number of polytechnics in Kenya's educational system -- will continue to produce the intermediate technical manpower to support agricultural research.

4.7 Other Institutions and Agencies

A number of other institutions and agencies are involved in aspects of agricultural research that complement the framework of research in the NCST, institutes, and ministries. The Coffee Research Foundation and Tea Research Foundation are concerned with research on the improvement, production, and marketing of Kenya's two most important export crops. Others, such as the Kenya Seed Company, the National Seed Quality Control Service, and agricultural development corporations, have research components that adapt, extend, and apply the work of national and regional research stations. Others in the private sector also undertake research of an applied nature on relevant production problems.

The Tea Research Foundation, which started as a research unit in the private sector of the tea industry in 1951, became a national institution in 1978 following the breakup of the East African Community. It was constituted into a foundation within the Ministry of Agriculture, with a new board of directors in 1980. Funding is through the Kenya Tea Board. Research to increase the production and quality of tea is undertaken by a small team of scientists and appears to be focused properly on breeding, selection, plant nutrition, soil fertility, fertilization, water use and crop management. Efforts are being made, through technical and socio-economic studies, to improve the production and quality of tea from the smallholder farms, which now produce about 70% of the crop -- worth

over K£100 million. Much of this work is carried out in collaboration with the Kenya Tea Development Authority (KTDA). Production has continued to increase steadily. There is evidence that yields are also increasing, but it is complicated in the average because of large areas of young tea just coming into bearing. Average yields of mature tea in estates have risen from about 2,000 kg/ha in 1970 to now over 2,500 kg/ha, with best yields between 3,000 and 4,000 kg/ha. Future research will focus on identification of the constraints and the direction of technical research to increase productivity. The foundation also has constraints of scientific manpower due to a rapid turnover of experienced staff after dissolution of the East African Community. Its scientific career structure should enable it to attract and retain competent staff as soon as the reorganization is completed.

The Coffee Research Foundation is a parastatal research organization funded by the coffee industry. It is directed by a board of directors and is responsive to the problems of the small- and large-scale coffee growers. Research programs are mainly articulated by the scientists, who maintain a close link with the industry; a research liaison service serves to strengthen the links with the extension services of the Ministry of Agriculture and the farmer. The foundation focuses research on agronomy, breeding, crop protection, crop physiology, and quality control of coffee. Major research achievements include the breeding for resistance to coffee berry disease, the control of pests and diseases, and the management of the crop for increased productivity. An agricultural economics unit undertakes diagnostic and analytical farm surveys to guide research and the development and adoption of recommendations. An active research staff of about 20 is engaged in well-coordinated research on this export crop, which is worth over K£180 million annually. The staffing has been relatively stable, and many of the present staff have been in the foundation for 6 to 16 years. (This is no doubt associated with a suitable scientific career structure devised to reward scientific research merit and productivity -- unlike the structure in the ministries and other parts of the agricultural research system.) Some constraints exist in the areas of specialized manpower, in-service training facilities, and technical services, but the foundation should be able to overcome these if it continues to be funded adequately and if priority is given to these constraints in planning. The foundation offers a good Kenya example of how a stable, responsive research service can contribute to agricultural development.

CHAPTER 5 ORGANIZATION OF RESEARCH PROGRAMS

5.1 Introduction

The research programs of the various ministries, institutes, educational institutions, foundations, and agencies identified in Chapter 4 are planned, organized, and executed through a network of research stations (and sub-stations), laboratories, departments, and other units which constitute integral parts of these bodies. For convenience of presentation here, the organization of these research programs is discussed under both subject and institutional headings. A final section of this chapter deals with the determination of agricultural research programs and priorities and presents some observations on problems and constraints in this area.

5.2 Research on Food Crops

Research on priority crops in the Kenya food economy is undertaken principally in 42 national and regional stations and sub-stations of the Scientific Research Division (SRD) of the Ministry of Agriculture, KARI, and the university and colleges (Fig. 5). Research in the past has drawn heavily on collaboration between scientific work, e.g., plant breeding, and commercial farming practices in the high-potential areas. The major breakthroughs have been in the breeding of maize, wheat, and barley for the highlands, and the development of short-season maize varieties for drier marginal areas. Little research has been carried out on the technologies necessary to improve food crop productivity of the smallholder farmers; it has been easier to introduce and adapt varieties of food crops and production methods to the high-potential areas. With the evolution of widespread smallholder production, and the need to increase food productivity rapidly to cope with the increasing population, new approaches are warranted.

Research focused on major food crops now deals with maize, wheat, barley, beans and other pulses, horticultural crops, sorghum, millet, cassava, and rice. Such research mainly concerns breeding for higher yields, adaptability, pest and disease resistance, agronomy, and crop protection. For the major staple food crops of maize, wheat, and vegetables, there are national research stations responsible for breeding, selection, and multi-locational testing of varieties for productivity and adaptability. Other stations and sub-stations work on food crops of regional or local importance and on the systems for the production of crops, livestock, and other commodities important for their farming communities. In addition, they cooperate with national research stations in the testing of improved materials (Fig. 6)

The National Agricultural Research Station, Kitale, for example, is responsible principally for research on the breeding and agronomy of maize and pastures. Considerable gaps exist between the experimental and demonstrated yields obtained from the combination of improved varieties and package of agronomic practices from this station: The average maize yields, for example, show potential of 10 t/ha and an actual average of less than 2 t/ha. The evaluation of these constraints in the context of the farming systems of these areas, and the development of suitable technologies to bridge this gap, appears to be of primary importance.

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Some useful socio-economic research on production constraints has been initiated in cooperation with technical scientists. The mission noted that the Kitale programs would require considerable strengthening in the areas of socio-economics, farming systems, and technical research to enable it to deal with the problem of the productivity gap. A planned program of in-service training is needed to increase staff capability.

The National Plant Breeding Station, Njoro, is responsible for the breeding and agronomy of wheat, barley, triticale, oats, and oilseeds and for coordinating research work on sesame, groundnuts, and soybeans. Research covers other areas of crop protection, soils, and crop utilization. The station has significant linkages with CIMMYT, ICARDA, and other centers engaged in related research. It exchanges materials and information with other international, regional, and national programs and stations. Many high-yielding and disease-resistant wheat varieties, as well as improved production practices, have emanated from the station. The station has received, and continues to receive, considerable support from international donors and other international assistance programs. The research and training programs at the station are strongly supported by CIDA. Gaps also exist here between the station's yields and production technologies and the average crop yields and practices in the relevant growing areas. The station is now concentrating on developing appropriate technologies for the production of wheat and other crops for the smallholder farmers in the zone. There is evidence that socio-economic inputs and field diagnosis of the problems are playing major roles in the development of research programs at the station. The station has also developed oilseed breeding programs with emphasis on sunflower, rapeseed, soybean, and castor -- in that order of priority. Collaboration with other national and regional stations is ensuring the introduction of improved oilseed crops into farming in such areas as Embu, Meru, and Machakos. The station's major constraints are in physical resources, procurement procedures, and scientific manpower.

The National Horticultural Research Station, Thika, is responsible for research into the breeding and production of horticultural crops, including vegetables, drybeans, fruits, root, and tuber crops. It also undertakes some research work in sericulture, post-harvest physiology, food technology, seed production techniques, and ornamentals. Research results and materials from the station promote and backstop production of fruits and vegetables for both local consumption and export. The programs in fruits, drybeans, sericulture, and root and tuber research are linked with relevant international centers and other programs, such as those at IITA, CIAT, and ICRISAT, and moderately supported by international assistance schemes. The major restraints are in specialized manpower and physical facilities for programs to serve a wider community.

The National Dryland Farming Research Station, Katumani, has the national mandate for the development of crop and animal production technologies suitable for increasing the productive capabilities of drylands -- about 10 percent of Kenya's lands receive between 500 and 800 mm of rainfall per annum. The station has adopted an integrated farming systems approach (which involves the management of the resources of soil, water, animals, and crops) designed to support and provide additional incomes for rural families in this zone. The focus which has emanated from diagnostic surveys of farming systems and constraints, emphasizes

land management methods, adapted varieties, soil and water conservation, fodder, forage, tree and animal production and management, and the development of economically viable production packages. Some progress has been made in land and water management, selection of adapted varieties of sorghum, pigeon pea, millet, maize, crop agronomy, mixed farming systems, and training. The research activities symbolize the shift in emphasis to increasing the productivity of marginal lands. The station is linked with KARI and supported by an active FAO/UNDP program in dryland farming. The program has a realistic approach to the problems in semi-arid locations, an area of greater priority in Kenya's national development plan.

The Coastal Agricultural Research Station, Mtwapa, is the major station in the Coast Province. It has been the subject of a study this year by the NCST, which presents a set of recommendations with which the team broadly agrees. In the past the station served only as a testing station for other national stations; but more recently it has designed its own short-term and long-term research programs. Those programs aim at the problems of agricultural production and farmers in the Coast Provinces, while maintaining strong linkages with other national programs. The coastal area is ecologically diverse, featuring the hot, humid coastal belt, the drier hinterland, and some higher-altitude coastal areas such as the Taita Hills. The agricultural production problems are peculiar, and a range of crops are important -- including coconut, cashew, maize, sugarcane, cassava, sweet potato, cowpea, and livestock (cattle, sheep, and goats). The team fully supports the recommendation that the Coastal Research Station be accorded the status of a NRS with the mandate for agricultural research on the Coast and special responsibility for tree crops (coconut and cashew). Such a recognition would necessitate considerable improvement in the infrastructural facilities, staff, and funding. The present staff of 16 Kenyans, the majority of whom are without postgraduate research training, is inadequate even for the present programs. The laboratory facilities are outmoded, and funding is inadequate for the approved research programs.

Although tree crops are regarded as a major commodity in the province, the research efforts are not commensurate with the importance of the crops. The current program, however, indicates that progress could be achieved under difficult conditions if the program has highly qualified and experienced leadership. There is need for research training for most of the staff at Mtwapa and for a high level of research leadership in the articulation of research programs that would make an impact on agricultural production on the Coast.

There is interaction with the Provincial Agricultural Research Advisory Committee (PARAC), the commodity committees, and specialist committees in the elaboration of the research programs of the station. A new farm economics research unit is beginning to make inputs for systems evaluation and identification of researchable problems. Although this system of research program determination is not entirely satisfactory as a basis of program planning and priority setting, the inputs of the extension services through PARAC are considered important and should have a place in any new system. The team agrees that when program budgeting is adopted, the station would know the programs that have been specifically approved for it and would not be forced into a position of having to spread its limited financial provisions over so many projects.

The major constraints are inadequacy of trained staff, inadequate provision of funds and facilities, bottlenecks in procurement procedures, and financial administration. The Coastal Agricultural Research Station has an important role to play in the agriculture of the Coast and, therefore, requires strengthening in terms of manpower, physical, and financial resources.

5.3 Research on Export Crops

Kenya's major export crops -- coffee, tea, pineapple, and pyrethrum earned about 46% of the total export earnings in 1979. Research on export crops has high priority; in the development plan (1979-83) they are expected to play an important role in earning foreign exchange.

Coffee, tea, and pyrethrum perform best under restricted agro-climatic regions and are to be found mainly in the high-potential areas between about 1,200 and 2,700 m altitude -- coffee occupies the lower altitude range. Quality is of great importance to obtain the best export prices. Small farmers' output can match the best estates; their problems arise mainly from costs of fertilizer, chemicals, and labor.

Coffee was introduced into Kenya before 1900, and the coffee research services were started as early as 1908. Research support expanded rapidly after 1947. Today the industry is served by a well-equipped research station at Ruiru and sub-stations at Kisii, Koru, and Meru. The research staff numbers 23, more than half of whom have postgraduate degrees; many have been at the station for more than seven years. The total budget is about K£1 million, but K£400,000 of this is generated from the experimental farms. The coffee industry took over responsibility for research in 1964, when the Coffee Research Foundation was set up, and most of the funding comes from a cess on coffee. (The total value of the crop fluctuates, but is about K£180 million.) The foundation has its own scheme of service, with promotion based on scientific qualifications and research output, not on an administrative or management system. It is believed that this professional service scheme has been important in maintaining stability of research staff. The board's policy is that first-degree training is not enough for research; therefore, training to MSc is sponsored by the foundation. It is also the policy to have at least two scientists per section, for continuity.

Research program proposals are scrutinized and approved by the Coffee Research Advisory Committee, which includes both large-scale and small-scale growers' interests. Critical and constructive feedback on priorities is not common from the committee; more relevant comments come from the research scientists and from discussions in the field with farmers. It is expected that useful guidelines will emerge from a current economic study of farmers' practices. Large pieces of the overall program tend to be "crash projects" designed to meet possible disasters, e.g., coffee berry disease, which threatened the industry in 1966-67.

Sub-stations are used for work on local problems and for demonstrations. Delivery of results to farmers is aided by a small staff in the research liaison training and advisory section, but most of the extension work is done by the Ministry of Agriculture's cash crop officers.

The research activity is carried out in seven sections; the latest, agricultural economics, started in 1979. A major thrust since 1969 has been on high-density planting, as wider spacing was proving uneconomic. The physiology, soil fertility, and agronomy sections have combined fruitfully to gain detailed understanding of the crop's requirements and to produce recommendations in this profitable new system of planting coffee. Coffee berry disease has dominated both the pathology and breeding research activities for some time. After an effective spray regime had been worked out to cope with the immediate threat, a long-term breeding program is seeking resistance to CBD and rust. There is some threat from bacterial blight, which is at present confined to the Solai/Elgon areas, but there is currently no bacteriologist on the staff. The entomology section is moving towards developing integrated pest management for leaf miner control and entomologists hope to use biological control methods against the berry moth (with cooperation from the specialist group at Muguga). Nematode problems are suspected but little work has yet been done on them.

The Coffee Research Station is well staffed and equipped, and its program seems well focused. It could serve as a model for other research stations. Part of the satisfactory situation seems to stem from the more realistic and attractive scheme of service for professional research staff and from a planned and consistent training program. It was also said that they had less difficulty with procurement of research supplies than did many of the national research stations.

The research establishment for tea, the production of which is valued at about 60 percent of the coffee crop, currently has only four research scientists, with four vacancies, at the single research station at Kericho. The staff and facilities at Kericho are similar to what was there in 1953, although there has been an enormous increase in area and tea production, bringing in 130,000 smallholders. The tea industry flourishes and the smallholders' difficulties over labor are those of success -- they no longer expect to use only family labor as originally planned in the KTDA schemes. The industry has been remarkably free from pests and diseases, and tea is usually grown where water stress is not likely to be serious. Furthermore, when the crop was introduced in the 1920s, a well-tried agronomic practice was transferred from overseas and adapted quickly to Kenyan conditions. Despite this situation, there seems to be little depth of research defense in tea should anything go wrong. A broader base would seem to be a desirable insurance.

Tea research was finally organized on an East African basis by the major tea companies. The Tea Research Institute of East Africa was established in 1951, and sub-stations were opened in Toro, Uganda, in 1957 and in Tanzania in 1967. The difficulties of operating in the other countries led the board of directors to phase out the old institute in 1980. The new Tea Research Foundation, within the Ministry of Agriculture on the same basis as the Coffee Research Foundation, was set up to continue the research activities, funded from a cess on the tea production.

The new mode of operation is not well established yet, and the previous research program is being continued in four sections: botany, chemistry, agronomy, and environment (physical). Crop protection and agricultural economics are absent, reflecting the remarkable absence of pests to date and the earlier management of tea in large estates.

Abandoned tea fields suggest that the new smallholders do not yet fully understand the risks and opportunities of intensive tea cultivation; some research input on the small-farmer system could be very helpful in highlighting new problem areas to be addressed.

Meanwhile the small research team has been successful in the past: carefully selected clonal material for East African collections gave much higher potential yields; nutrition and benefit of weeding with herbicides were demonstrated; the detrimental role of shade in well-managed tea was clarified; and better establishment and pruning methods were evolved. Clonal selection is continuing and drought tolerance is being sought. The tea bush currently produces 40 percent of dry matter as useless wood; investigations are in hand to try to reduce this proportion.

The major constraint on research at present is shortage of manpower. Many diplomate supporting staff left at the same time as research staff in the period of uncertainty before the foundation was established. A new scheme of service is to be adopted, presumed to be similar to that of the Coffee Research Foundation, but it is not in action yet. The contrast in staff stability and continuity is evident, part of which is due to the scheme of service for professional staff in the Coffee Research foundation.

5.4 Research on Industrial Crops

Sugar has been a traditional crop for a long time, but estate production is more recent and has grown rapidly since the decline of the Ugandan industry. The National Sugar Research Station was established at Kibos in 1968-69 with the main aim of providing growers with high-yielding and disease-resistant varieties of cane. Breeding was then done on an East African basis by EAAFRO, initially at Mtwapa and finally in Tanzania. It is now proposed to reactivate sugar breeding at the Mtwapa research station. Meanwhile promising varieties are imported from appropriate collaborating research centers overseas for testing at Kibos and at sub-stations in South Nyanza, Mumias, and at the Coast. Other trials are carried out on the estates. Most estates carry out their own agronomic trials, but a program has been started to adapt tractorized methods to small farmer, oxdrawn conditions, and to examine the potential for intercropping with grain legumes and maize. Adverse soil conditions, especially drainage, are seen as a constraint that has not received adequate research attention; a new research thrust is planned in this direction.

Although sugar is an important estate crop, research is funded fully by the government. There is no direct cess, nor is there any research foundation with terms of service geared to research productivity. Senior research staff have been difficult to retain in face of competition from estates. Currently there are 11 graduate research staff in position (1 Ph.D., 1 MSc), and further training opportunities are urgently needed. Some extra senior staff are due to be provided under a World Bank program -- which will include a production economist -- and two senior expatriate scientists were expected from India in October 1981 to assist in breeding and drainage research. The laboratory facilities can support only a modest program and are inadequate for the expansion proposed. Good relations are maintained with the Mauritius Sugar Industry Research Station and with the sugar research centers in India.

The Cotton Research Station at Kibos was established as early as 1951 with support from the Cotton Lint and Seed Marketing Board, with research staff from the former Empire Cotton Growing Corporation. It was taken over by the Ministry of Agriculture in 1968, but no great emphasis was placed on cotton until recent years. In 1978 the government decided to stress self-sufficiency in the supply of cotton, partly from the higher rainfall areas of Western Kenya and the Coast, partly from the drier areas of Central and Eastern Provinces, and partly from irrigated areas. Earlier policy had been to grow only Grade A quality cotton for export and to import lower grades for local manufacturing; textile factories are currently geared to operate on shorter staple cottons. A survey is proposed to assess the demand for cotton of different staple length.

Meanwhile a station for research on cotton for drier areas was established in 1975 at Tebere. This has been absorbed into the Mwea-Tebere Agricultural Research Station, which has been assigned the responsibility for coordinating cotton research in the country. In addition to these two main stations, there is another cotton research station at Msabaha on the Coast, an extensive range of sub-stations, five in the drier areas and three in Nyanza Province. The National Irrigation Board supports some research on irrigated cotton at Hola. Research policies and programs and results are scrutinized by the Cotton Research Advisory Committee, which lays down guidelines for the programs at research stations. The main research areas are in selection and breeding, pest control, and agronomy. It is hoped to add research programs on post-harvest processing and quality assessment, economics, and crop physiology.

Crop improvement has proceeded mainly by testing of introductions from elsewhere and selecting among the commercial lines, but a hybridization program has been started at Tebere with accent on early maturity and quality, although the latter aspect has been restricted due to a lack of fibre-quality testing laboratory. Pest control work has been concentrated on assessment of available pesticides, the methods of application, evaluation of development of resistance to insecticides by pests, and the influence of intercropping on pest incidence. With extra staff it is proposed to examine further cultural control methods and the possibilities of biological control. The agronomic program is re-evaluating earlier fertilizer work that seems to have led to inappropriate recommendations; examining micronutrient requirements; examining spacing requirements of new varieties; and studying the possibilities of herbicides for weed control as labor becomes more expensive. In the Eastern area better cultivation techniques for water conservation are being sought.

The program is restrained by shortages of experienced research staff. Further specialist training in research is urgently required. At Kibos, there are four research officers concerned only with cotton; at Tebere there are eight Kenyans and two expatriate research officers, but some of their time is given to research work on sunflower and upland rice. The proposed research staff is seven at Kibos and 16 (on cotton only) at Tebere. World Bank Support via IADP will provide for an extra two expatriate research officers for cotton in 1982. Farm facilities are severely restricted at Kibos with only 25 acres, while office and laboratory facilities at Tebere are only moderate but expanding. There is urgent need for a national cotton fibre quality testing laboratory if

Kenya is to produce all the range of cotton staples the industry will require.

5.5 Kenya Agricultural Research Institute

As described previously, the Kenya Agricultural Research Institute was established in 1979 as one of the statutory research institutes to have concern for all national agricultural research and to continue some of the appropriate work of the EAC research institutions as part of the total agricultural research system. KARI has a Board of Management with an independent chairman, appointed by the Minister of Agriculture, and 11 members plus representatives of the Permanent Secretaries of the seven participating Ministries. The membership includes the director of KARI, the secretary of ASARC, and currently includes the directors of agriculture and livestock development, and the science secretary of NCST. Funding for KARI comes by grant-in-aid through the Ministry of Agriculture.

The Board looks forward to the stage when KARI will have developed enough to assume the leading role in the execution of the national agricultural research plan. It has tentatively prescribed a phased approach with initial responsibility for (i) operating the facilities of the former EAAPRO and EAVRO, to carry on aspects of the former EAC research program, (ii) for the whole of forestry research, and (iii) to develop a new regional research program to serve the general research needs of the farmers in the immediate area of the Central Province.

KARI has suffered from the slow decline in the effectiveness of the EAC organization. Before KARI was established, many experienced Kenyan staff left Muguga for more secure positions elsewhere; in addition there was loss of staff from Uganda and Tanzania. Nevertheless, it remains a powerful institution with 59 Kenyans and 18 expatriate research officers and a wide ranging research program in its four departments -- veterinary research, animal production, forestry research, and agricultural research. The office, laboratory, and housing facilities are good; the library is excellent; and the farm facilities for some aspects of livestock research are good. However, the seasonal rainfall is low for reliable arable crops, and there are no dairy facilities.

The research program of the Veterinary Research Department has been well coordinated with that of the Veterinary Research Laboratories at Kabete, and with ILRAD; it is essentially following the same program as in EAC days. The department has the major responsibility for research and vaccine production for rinderpest, contagious bovine pleuropneumonia, and contagious caprine pleuropneumonia. It also carries the main national responsibility for research work on East Coast Fever (ECF). It has developed special research competence and facilities in the areas of protozoan and viral diseases that are of strategic importance to the country. There is also a research program on important helminth parasites, especially tapeworm in cattle and liver fluke in sheep.

In the past, it had been hoped to concentrate on disease research and vaccine development efforts, and pass on responsibility for vaccine production to other organizations. Now the livestock department and the board of management see the need for vertical responsibility to be assigned to one of the organizations to control and monitor vaccine production. The laboratory is the source of rinderpest vaccine for the

whole of East Africa and elsewhere, and the load of production (about 10 million doses per year) is heavy and increasing. Facilities for production could be improved greatly with a supply of better equipment, to be housed in a building already completed but which lacks appropriate equipment.

The pioneering research work of the former EAVRO on ECF, the major disease, is being followed up at Muguga and at ILRAD, with appreciable inputs from ICIPE on the ecology of the tick vectors. The research work on ECF (and trypanosomiasis) is coordinated by the effective, if informal, "Nairobi Cluster", which includes the veterinary research laboratories in Kabete, ILCA, and KETRI, in addition to the Veterinary Research Department at Muguga, ILRAD, and ICIPE; good collaboration is maintained with research groups in Utrecht and Edinburgh. Many aspects are being examined in some detail. In the Muguga program emphasis is placed on seeking greater understanding of variation in strains of the pathogen and their mechanism of pathogenesis, the epidemiology of the disease, and the possibilities of controlling via immunization, chemotherapy, and tick vector control. ECF is a major hazard in East Africa, and losses of improved cattle still run at between 50,000 to 80,000 animals per year, despite an intensive dipping regime. Two promising drugs are ready for extensive field trials planned in Masailand, but funds for compensation to cattle owners are not yet assured. There are additional studies on virus diseases, such as African swine fever, and on malignant catarrhal fever, which is transmitted by wildebeest.

There are currently 40 scientists on the staff, including 14 expatriates (two from ICIPE). The Kenyan staff is relatively inexperienced, but 12 have MScs (with six more on training overseas) and two have PhDs (with three more registered for Ph.D).

The research programs of the Veterinary Research Department could be carried out almost anywhere in Kenya where the main diseases are present, provided the elaborate facilities were available. Although aspects of vector control might be sensitive to particular farming systems, the nature of the research program is not particularly restricted to any region.

The veterinary research program at Muguga has not had any major break in continuity; it is well integrated into the national research program, and regular discussions with other research groups ensure that there is little or no overlapping of research effort. Linkages with the veterinary extension staff are also good because of the need to train staff in the use of vaccine produced at Muguga and the need of scientists to monitor their effectiveness. Feedback is rapid and direct. The program is sound, realistic, and directed towards important diseases. There is an urgent need to ensure that all graduate staff receive further training in appropriate research methods and approaches.

The Forestry Research Department, with the agreement of the Ministry of Natural Resources, undertakes all forestry research under the jurisdiction of KARI. A Forestry Research Advisory Commission has assisted in drawing up a comprehensive national research program for the department, which is organized in four divisions: silviculture and forestry environment, entomology, pathology, and utilization, to which it is hoped to add a division of forestry mensuration and economics.

Current research activities continue to back the earlier policy of generating useful industrial timber by replacing indigenous forests with plantations of rapidly growing exotic species. The new program is directed towards managing the existing forest productively on a sustainable-yield basis and to the development of farm woodlots and rural afforestation in marginal areas, mainly for provision of fuel, but also for fodder and construction timber.

The department has on hand 9 Scientific Research Officers -- of whom 7 have MSc and 2 are in training. These are mainly involved in research on silvicultural techniques and pest and disease control for plantation species. It is estimated that at least 20 more research staff will be needed to mount meaningful research studies in the new program, which will include research on management of commercial trees with better understanding of the role of non-commercial species in a dynamic system; supporting soil science studies for the establishment of forests and private woodlots in high-potential and in arid and semi-arid areas; examination of the potential for extractives (oils etc.) as new wood products; and ways to strengthen the capacity for economic appraisal of forestry operations.

The program will involve the establishment of new research sub-stations for studies of establishment and development of forests and tree lots in arid and semi-arid lands. Currently there are regional research stations for plantation forests at Muguga/Karura, Londiani, Turbo, and Gede (for the Coastal region). Sub-stations for forestry research in marginal areas already exist at Hola, Kibwezi, and Ramogi; it is proposed initially to add two more, at Lodwar and Marigat, with one research officer at each station.

A full program has been drawn up in forestry research in the country as a whole, but no priorities have been assigned to guide use of limited manpower. The need has been recognized for new research on the establishment of woodlots on private land, especially for fuel and fodder, and for examining suitable species and techniques for establishing trees in arid and semi-arid lands. However, work in these areas is described as "new projects" and would presumably require new manpower. Most of the existing staff are working on problems of plantation forestry in high-potential areas and there are few likely to be left over for the research to back the thrust for social forestry.

Little is known about tree species and techniques of establishment in the dry areas of Kenya. Some intensive, interdisciplinary research effort is likely to be needed to gain new knowledge rapidly and to make possible the formulation of new practices for testing. It seems premature, therefore, to consider posting single research staff to new sub-stations in arid and semi-arid areas until there is a new technology to test; even then it seems unlikely that an isolated research officer will be able to accomplish appreciably more than a forest officer or a technician. It would be a better policy, technically, to maintain research groups, each with interdisciplinary research strength, in one or two representative sites than to spread this scarce research staff too thinly in this early phase of research.

Animal Production Department

Previous emphasis in research in the EAC organization was on beef cattle production, but most of the staff involved with that program

left. The new program at the Animal Production Research Department is proposed to be oriented towards dairy cattle with special reference to the local environment of Central Province. It will be based mainly on stall-feeding of Napier grass, but pasture, fodder and concentrate feeding will also be examined under both grazing and confinement. As livestock is being pushed away from the high-potential areas, problems of milk production in the drier areas will also be studied, using the Athi River farm facility.

A broad future program is proposed, including breeding and genetics; studies of dairy cattle; dry season nutrition for milk; nutrition of beef cattle; extensive systems and physiological adaption to sub-maintenance nutrition; and sheep, goat, pig and poultry research, but the details have not been discussed in relation to the existing research programs in the Ministry of Livestock Development.

The overwhelming constraint is lack of experienced research staff. Currently the department has only three research officers (one expatriate) in addition to the deputy director; a minimum of 15 officers is envisaged to provide a critical mass of competence in animal production research. The only other substantial group involving dairy animals is at Naivasha, with a total of only eight research officers for a similar range of activities. Few animal science graduates are being produced by the university, and competition is severe. There is also a serious shortage of technical staff. The major capital requirement as presented is for new dairy stock and a research dairy parlor.

The department was disrupted at the termination of the EAC, and the current research program on the nutrition of beef cattle virtually stopped. Unlike the Veterinary Research Department, the new thrust towards dairy cattle differs from the preceding program and would entail buying new stock, developing new dairy research facilities, and training junior staff in new techniques. The proposals for the future program are broad and comprehensive and will require a large research staff in a nationally coordinated effort.

The national manpower resources engaged in animal production research are small in comparison to the importance of livestock in the farming systems of Kenya; there is a great need to increase the research effort on all aspects of livestock production. Nevertheless, there are several groups involved in animal production research and development, and valuable reserves of high quality livestock are held by ADCs. It would seem vital for an efficient national research program that thorough discussions be held among those concerned with livestock research before a new program for any component of the national research system is made final.

The Agricultural Research Department inherited the facilities and specialized research program of the former EAAFRO at Muguga. It has developed a new research program, building on elements of the previous one with proposals for new projects having special reference to the Central Province and the semi-arid lands. Since Muguga is neither a reliable site for arable crop production or representative of a large area of drier lands, much of the field work is planned to be carried out in association with staff at other national research stations.

It is estimated that 44 research officers will be needed in addition to the current staff strength of 14 Kenyans and 10 expatriate research

officers. Such a major expansion is clearly related to the overall strategy for national agricultural research. The proposals are relatively new, and they have not yet been discussed at a national forum.

The crop protection program reflects the specialized research strength in virology, nematology, epidemic entomology, and biological control techniques -- all of which are to be applied to important pests and diseases. Expansion is proposed in mycology and bacteriology to parallel proposed development on seed-borne diseases within the plant quarantine program. Another new program on weed science is proposed with concentration on herbicides and "eco-fallowing" systems. The Dryland Cropping Systems project (within the farming systems program) also builds on previous research experiences and competence at Muguga; it focuses on the problem identified in the national plan of devising better arable farming methods in the semi-arid areas. The broad-based multidisciplinary team seems well-suited to make an important contribution in cooperation with the Scientific Research Division/FAO group based at the Katumani Research Station. The new project proposed on agricultural engineering relates to previous intermittent attempts to establish national competence in implement testing and evaluation -- which was primarily geared to large-scale farming. The new project would stress design and evaluation of simple implements for the smallholder farmers.

From the historical position of strength in the crop protection program, there seems justification to continue a research project in virology, nematology, epidemic entomology, and biological control, but less clear justification for the new projects in mycology and bacteriology, for which other national centers of competence are available. However, there is a continuing and increasing need for plant pathology expertise in the plant quarantine program, especially on seed-borne diseases; this expertise could also be applied to more local or regional problems. Weed control is an important aspect of all farming practices, and it would be valuable to have somewhere a national center for weed science expertise on all crops and for evaluation of herbicides. This could be at Muguga or NAL, as any such center would be an extensive network of testing sites. The specific justification on the basis of "eco-fallowing" should be examined carefully with respect to the declared objectives of relating research to small-farmer systems of cultivation.

The dryland cropping systems project seems well conceived and justified. The project proposed on agricultural engineering for the development of the national research competence for designing and evaluating simple instruments for smallholder farms is sound. It deserves a place in the plans for the national agricultural research system. However, it is not so evident that the physical establishment at Muguga would be particularly appropriate. It is difficult to grow a wide range of crops there, and the soils are easily worked, they are not typical, and there is no large engineering workshop available.

The crop improvement program is a continuation of an EAC program in which EAAFRRO had played an important coordinating role, especially with regard to methods of breeding and improvement in maize and sorghum. The department proposes to continue to provide leadership in a new maize breeding project and will involve seven maize breeders in developing varieties suitable for widely different environments in Kenya. The

miscellaneous food crops breeding project proposes six breeders to be involved in the improvement of sorghum, millet, grain, legumes, and other crops. The plant genetic resources conservation project is another new proposal that needs centralized coordination, and it is clearly linked with the services already provided in the plant quarantine program and the herbarium. There is, in addition, a proposal for a horticultural crops program which is extensive but is not yet worked out in detail.

The research program of the former EAAFRO was largely separate from, and complementary to, that of the research division of the Kenyan Ministry of Agriculture. Integration of that program into the national research system poses some problems of adjustments which merit national discussions that do not seem to have been completed for certain aspects.

The crop improvement program poses difficulties. EAAFRO had played an important coordinating role in maize breeding, but some problems remain in its transition to Kenya. Although KARI has been providing a substantial technical assistance in the maize breeding program at the National Research Station at Kitale, there is little logic for retaining the coordinating center at the Muguga Station with a team of seven maize breeders; it appears more logical for the national responsibility for the program to be set at Kitale, with strong sub-programs at sites in less favored areas.

This dilemma highlights the importance of having a unified national research strategy for all agricultural research, with each station assigned responsibility for the program appropriate to its comparative advantage and importance in the national plan. Breeding projects for miscellaneous crops -- such as sorghum, millet, grain legumes, and other -- are high priority topics that need to find a place in the national research program, but not necessarily associated with Muguga. A new proposal for a horticultural crops program seems to have a major area of overlap with the responsibilities of the National Horticultural Research Station; despite the essential services offered by the plant Quarantine Station, there seems little cause for initiating at Muguga a program for improvement of horticultural crops.

The herbarium and plant quarantine programs are specialist research services of a high order that were originally built up to serve an area wider than Kenya. They will have strong international connections and are of great value to research and development activities in Kenya. Their unique strength should be maintained and support is deserved for the proposed research projects on seed-borne diseases and tissue culture techniques to eliminate plant diseases from material. The library at Muguga is also a specialist resource of great value. Its contents page circulation and reprint services are considered valuable by the staff at nearly all the research stations.

The overall research program of KARI indicates that there seems to be some confusion between the role of the Muguga Research Station and that of the Kenyan Agriculture Research Institute, in the country as a whole. In the team's opinion, the research station at Muguga, like the veterinary research laboratories and the National Agricultural Research Laboratories at Kabete, seem to be well suited to providing certain specialized research services and to carrying out some research on a national basis; but the station is not well suited to serving as a regional research station because of its lack of representativeness. The

team noted that the KARI Board of management has been compelled by circumstances to interpret the role of KARI in terms of a research station to fill in some of the gaps in research and to serve the needs of the Central Province. It would seem desirable that, in the view of the structure, organization, and management recommendations in Chapter 9, the Board should reconsider the role of KARI and provide direction and focus for it to serve as a semi-autonomous national institution for the organization, coordination, and management of agricultural research in Kenya. The team suggests close collaboration and interaction of KARI with the Ministries of Agriculture and Livestock Development and the other participating ministries and agencies in which components that will constitute the comprehensive research organization are now based.

5.6 National Agricultural Laboratories, Kabete

Research work at the National Agricultural Research Laboratories, Kabete, dates from 1903. It initially provided analytical and veterinary services but soon began research work on crop production. New crops were introduced through the station, including coffee, tea, wheat, and pyrethrum. As crops became established in favorable areas around the country, responsibility for research on particular crops was transferred to research stations in the production areas. The National Agricultural Laboratory concentrated on providing specialist research services to the whole research system, especially in land and water resources (36 scientists) and in plant production (24 scientists).

The soils and agricultural chemistry section provides a specialist service for plant and soil analysis, feedstuffs and water quality. It also carries out research on efficiency of fertilizers, amendments to problem soils, maintenance of fertility under intensive cropping, nitrogen fixation by legumes, critical levels of nutrients in plants, and clay mineralogy. It has well-equipped analytical laboratories and is concerned with research on improvement of methodologies, besides serving as a center of expertise and interpretive capacity for soils and plant nutrition problems. The Section has a staff at headquarters of 7 research officers (4MCs) and 9 assistant research officers.

The irrigation and drainage section is relatively new, launched in a project with technical assistance from the Netherlands. It is intended to provide a center of competence on problems of water management, associated with both rainfed and irrigated conditions. Studies have been carried out on water management and use in red soils in the Upper Tana, salinity development in Lower Tana, and on drainage problems and reclamation plans at Yala swamp. As expatriate staff are leaving after the establishment phase, there are currently three Kenyan research officers (soils, irrigation, and social science). A substantial research program has been prepared from well-identified problems that would require additional staff.

The Kenya Soil Survey based at the National Agricultural Laboratories is well established with a total staff of 16 Kenyan scientists covering soil survey and analysis, land classification, vegetation, and climatological aspects. Four are in MSc courses at the University of Nairobi. An exploratory survey of 1:1 million is completed and reconnaissance soil surveys for some areas in both high- and low-potential areas have been done. The unit also carries out semi-detailed surveys on request. Demand is high and priorities are decided by a broad-based advisory committee.

The entomology section provides central research and reference service on insect pests; it works on more basic aspects of pest problems, with special reference to field crop and storage pests. Field studies are mainly concerned with the biology and control of pests of horticultural crops and tea. The section also screens and advises on all new insecticides and acaricides, and it operates a pesticide control service to ensure that standards are maintained. A pesticide residues unit examines levels and effects of long-term contamination on plant, soil, and water. The section (together with the pathology section) is closely linked with the plant quarantine operations at Muguga to avoid introduction and export of pests and diseases. The entomology section at headquarters has 14 research officers (linked with 18 more at Mtwapa, Thika, Mwea, Njoro, and Kibos). Leaders consider that more strength is needed in crop storage work and in the servicing of Acts of Parliament with respect to pesticides -- which would also be facilitated by more efficient equipment for analytical work.

The plant pathology section provides a central research service as a plant disease clinic to identify and advise on diseases and nematodes, and on the screening and use of fungicides. Its specific field research program is concerned with seed- and soil-borne diseases in intensive minor irrigation schemes where conditions are different from those in traditional rain-fed agriculture. Yellow mottle virus disease is providing a problem for rice cultivation at Ahero and the varietal screening for resistance is underway. Aetiological studies of pyrethrum wilt, bacterial wilt in potatoes, and coconut borer are being carried out. Many more such studies are needed in connection with seed certification rules, but they are restricted by shortage of staff, especially in virology. The section currently has 10 research officers, but only one has many years of experience. Four are new, and the other five are in MSc courses. The unit is reasonably well-equipped and has good support staff.

The essential research and services carried out by NAL do not appear to be duplicated elsewhere in the system. The team recognizes the need to strengthen the activities of NAL as part of the national agricultural research system through training, provision of equipment, and adequate funding. Training needs are particularly acute in the areas of soil science, crop protection, water management and agricultural chemistry. NAL would form part of the Nairobi complex of research and research-related services institutions made up of Veterinary Laboratories at Kabete, Muguga Research Station, etc.

5.7 Other Research and Associated Services

Nearly all the agricultural research stations in Kenya provide some specialized services, either in support of other research programs or as inputs into the advisory and extension services. The most important of these are the plant quarantine, soil sciences, plant protection, seed quality, and work and environmental resources management.

5.7.1 Plant Quarantine

Established at Muguga in the early 1950s, the Plant Quarantine Service has been used effectively to control the introduction of plant diseases and pests into Kenya, Uganda, and Tanzania. An example of its effectiveness is that the tea crop in East Africa is still free from the

diseases and pests found in the Asian countries, and many diseases of rice and horticultural crops have been kept out of the region. With the termination of the EAC in 1977 and the subsequent breakdown of the joint efforts to maintain uniform phytosanitary standards, there is danger of introducing new plant diseases and pests that could cause serious setbacks in crop production in Kenya. An important aspect of this research is the continuous research into methods of identifying seed-borne diseases and the possible cleaning up of valuable germplasm through meristem culture techniques. For this reason the service should continue to be managed under research services in order to retain and improve its scientific competence.

5.7.2 Soil Sciences

Efficient land utilization and use of fertilizers is dependent on knowledge of the soils, their behaviour, and reaction to various aspects of management. The national Agricultural Laboratories are providing a valuable service to agriculture in the survey and classification of soils, and a new program is underway to build up competence in irrigation and drainage. As in the case of plant quarantine, these services require supportive research activities and should continue to be managed as an integral part of research services. The soil analytical services are being decentralized to provide easy access to farmers in various parts of the country. While this effort is in the right direction, there is a danger of diluting the scientific competence through technical isolation of the few scientists who have been trained so far in this discipline. It is suggested that while the routine analytical services may be decentralized, the core of the research and improvement of methodology to backstop these services should remain and be strengthened in the National Agricultural Laboratories.

5.7.3 Plant Protection

Apart from routine plant protection services, which form part of the extension services of the Ministry of Agriculture, there are two technical sections based at the national Agricultural Laboratories that deal with both diagnostic and research aspects of plant pathology and entomology. A new section of pesticide screening and control is also being established at NAL. These sections are headed by senior research officers who report directly to the director of research. These activities provide an important linkage with the farming community, and their activities need to be decentralized to be more accessible to farmers. This has been achieved to a certain extent since major crop programs now have entomologists and pathologists attached to them, but the coverage is far from adequate and needs to be strengthened.

5.7.4 Seed Quality

The final product of a plant breeding or crop improvement program is seed or planting material. The best genotypes are of little use to the farmer, however, without an efficient multiplication system that ensures quality. The mission team reviewed the services provided by the national Seed Quality Control Service (NSQCS) and the Kenya Seed Company. The former operates under the management of SRD, and a report has been produced outlining the role of this service and the plant breeders in the implementation of the Seed and Plant Varieties Act. It is obvious that NSQCS will require substantial operational funding and trained manpower

to cope with its responsibilities under the Act. Research has an important role to play in this service, and there is great merit in retaining the NSQCS under research management. Kenya Seed Company already operates an efficient system for the multiplication, distribution, and marketing of improved seed. Its production, demonstration and processing facilities are well planned and managed. It will no doubt remain an important element in the improvement of crop production in the future.

5.7.5 Water and Environmental Resources

Considering that Kenya's agriculture is heavily dependent on rainfall and other climatic conditions, and that the declared objective is developing agriculture in the lower rainfall areas, the mission was surprised by the almost total lack of research expertise or scientific thrust in research manpower development in the fields of agroclimatology and water resources management. Only one agroclimatologist based in the Kenya Soil Survey is in training. This is a matter of great concern, considering that Kenya has an Institute of Meteorological Training and Research, as well as a department of meteorology at the University of Nairobi. The latter institution has relied on part-time staff to teach the subject of agrometeorology at post-graduate level for the past two years -- it has so far failed to recruit qualified agrometeorologists to its teaching staff. The majority of the students undertaking this training are non-Kenyans. The team, therefore, recommends this area of training as a high priority in the overall effort to strengthen agricultural research. It will play a key role both in research and development of dryland agriculture.

With the increasing demand for the specialized services outlined above, and the absence of program budgeting, there is a real danger of diverting most of the available resources to provide specialized services at the expense of innovative research. It is recognized that the same scientific personnel are called upon to perform both research and service functions; in some cases research seems to have been accorded lower priority with subsequent loss of productivity. There is a need, first, to identify clearly the proportion of research and development resources that should go to research and to research-related services as two important sectors, and, second, to ensure that these allocations are adhered to at all levels, including the research station level.

5.8 Research in Livestock Development

Research in the Ministry of Livestock Development covers the fields of animal production, range science, and animal health. The Ministry also strongly maintains that pasture research, currently in the Ministry of Agriculture, is crucial in the development of the livestock industry and therefore continues to work towards the phasing of pasture research into the Livestock Development Research programs.

The research programs are being conducted at three national research stations of the Ministry to which are affiliated fifteen regional research stations and sub-stations. These are supplemented by livestock research activities in seven agricultural research stations. The total research staff establishment in the Ministry's research division at the time of the team visit was 100, including 19 expatriates. Of this number, 33 are in training for MSc. degrees, 23 have MSc. degrees, 13 have Ph.D. degrees, and three are registered for Ph.D. degrees.

An important new headquarters facility is a Socio-Economics Unit. For this unit, 2 economists, 2 sociologists, and a statistician have been recruited. Small farming system units are being established at Kiboko and Naivasha. The central computer-backed unit is expected to be the strongest facility of its kind in Kenya.

5.8.1 Animal Production Research

The main research programs are at the National Animal Husbandry Research Station at Naivasha. The station has 13 research officers, 6 of whom have MSc. degrees, 3 currently are registered for MSc. degrees, and 2 for Ph.D. degrees.

The main areas of research are animal breeding and nutrition, and the classes of stock covered include cattle -- beef (Sahiwal), and dairy (Friesian) -- sheep, goats, pigs, and poultry. An emerging area of emphasis is dairy goats to cater for the smallholder farmers with limited land in high-potential areas. The dairy goats research program is the largest foreign aided (largely USAID) program in animal production. It is interdisciplinary with seven specialities: sociology, economics, farming systems, animal health, animal breeding, forage development, and animal husbandry (systems analysis). Five American research institutions and universities are collaborating. Each discipline provides at least one scholarship per year and three Kenyans associated with this program are currently undertaking MSc. training.

Another research project targeted on the small farmer at Naivasha is the Poultry Research Project which is assisted by The Netherlands. This is aimed at producing improved cockrels for cross-breeding with local hens. Marked improvement in egg production in participating small farms is already apparent.

The purpose of the Sahiwal Stud at Naivasha is to produce bulls for cross-breeding with indigenous small East African Zebu cows for the improvement of both meat and milk yields. The program has been particularly successful among pastoralists, especially the Masai. A recent ILCA study revealed that in certain areas of Masailand, up to 40 percent of the herds are Sahiwal crosses. Breeding and selection in the Sahiwal herd continues at Naivasha to obtain better yielders. Kenya has one of the very few remaining pure Sahiwal herds in the world and the Stud, therefore, is of global interest.

At the time of the team's visit a total of seven animal scientists of the Ministry of Livestock Development were participating in research projects at Kitale, Kakamega, and Katumani Agricultural Research Stations in aspects of pasture and nutrition targeted at both the large scale farmer (Kitale) as well as the smallholder (Kakamega and Katumani).

Some of the other facilities where animal husbandry research was in progress were Mariakani, Lanet, Maseno, and Ol Joro Orok. As will be mentioned elsewhere, some of these facilities are in great need of strengthening.

The National Range Research Station, Kiboko, was founded as an offshoot of the research component of the FAO/UNDP Range Project in 1971. It has the national mandate for research into the problems of range management for animal production, including ecology, rangeland

improvement, wildlife and livestock interactions, training, and development. The station grew slowly in the period 1971-1979, but was reactivated with the joint inputs of the Government of Kenya and USAID (through Winrock International) in institution building, training, and research in 1979. The main station at Kiboko covers 30,000 ha representative of two of the major rangelands in Ecozones IV and V; a sub-station of 2,000 ha is maintained at Buchuma in the Coast Province.

The research programs are determined at the station level on the basis of the National Development Plan, the livestock development policies, and with inputs from PRAC and the specialist committees on pasture and range research. The focus is on improvement through research on range management, grassland improvement, pastures, dryland cropping systems, and animal breeding (cattle, sheep, and goats). Although there is cooperation with other stations engaged in animal production and other related research and projects, e.g. Naivasha, there's need to strengthen the mechanism for the coordination of the livestock research and development programs and the allocation of responsibilities. The Ministry of Livestock Development has recently organized meetings for discussion to avoid duplication of efforts and to strengthen collaboration.

The major constraints are with the staffing and with inadequate funding. The station has a staff of nine Kenya graduates and four diplomates who interact effectively with the Winrock staff currently engaged with range research at the station. It is expected that 18 Kenyans will be trained to higher-degree levels before the project terminates in 1985. Basic difficulties exist in finding suitable trainees and in retaining them after training; the station has lost six staff trained under the previous project to other sectors of the economy. Although a marked increase is expected in the number of potential trainees in range science and animal production, with development and expansion of the relevant programs at the University of Nairobi (a proposal which the team fully supports), it remains to be seen whether the Kiboko project will be able to train and retain the full complement of research staff by 1985.

It is important that the training program and the thrust in range research be maintained after 1985; this could be achieved by the extension of the project, or by the government taking over the training of staff after 1985 and making provision for the retention of some Winrock staff for interaction with local staff until they acquire enough experience on the job. When the station attains its full complement of staff, it will address the major problems in animal breeding, animal nutrition, wildlife and livestock research, ecology, grazing systems, rangeland sciences and technology, biometeorology, soil and water conservation, and rangeland economics for the semi-arid areas. There is need for immediate improvement in the funding of the station to meet its constraints in infrastructure, transportation, library and documentation, and research results delivery.

The station collaborates with Kitale and Katumani on pasture grasses breeding and evaluation; with Naivasha in animal breeding; with Muguga on dryland cropping systems; and with the extension services in range management and animal production: these need to be strengthened. Effective collaboration also exists with ILCA and KREMU in rangeland ecology and monitoring; with CIMMYT in range management economics; and

ILCA and CIMMYT in farms systems research in the rangelands. The work in the Kiboko station represents a meaningful research thrust of great potential in bringing the semi-arid and arid lands of Kenya into livestock production and systematically increasing the agricultural productivity of these marginal areas. The program will further sharpen its focus with time; it requires considerable and consistent technical, financial, and training support over the next 10 years to enable it to have major impact on the agricultural economy of the country.

5.8.2 Veterinary Research

The Veterinary Research Laboratory at Kabete was built in 1908 and was the first livestock research laboratory in Kenya. From the very outset its primary work was to diagnose livestock diseases and develop vaccines to combat them. A good number of African animal diseases were first described at Kabete. This main laboratory and its satellite laboratory at Embakasi (The Foot and Mouth Disease Laboratory) still produce more vaccines, both in volume and variety, than any other laboratory in East, Central and Southern Africa. Most of its research is aimed at producing new vaccines or improving existing ones. Some research is also aimed at developing new or better diagnostic tools. For those diseases where vaccines are not yet available, research is carried out into alternative preventive measures such as utilizing drugs or controlling of vectors. At the time of the team's visit there were eight foreign-assisted projects in which six donors were participating. Funds for five additional projects involving five foreign agencies were pledged for 1982/83.

In support of the foreign-aided projects there are 14 expatriates. This number is expected to rise to 22 during 1982/83. The number of local graduates is projected to increase from 56 to 75 by the end of 1982. Less than 10 years ago, veterinary research was carried out largely by expatriate staff. As a result of this, local research staff is mostly young. Only 9 have postgraduate degrees and 25 (44.6 percent) were at different stages of postgraduate degree training. Among the 14 expatriates, 12 had postgraduate degrees (8 with Ph.Ds).

In addition to the main laboratory at Kabete, there is the Foot and Mouth Disease Laboratory at Embakasi where 6 virologists are located. To assist in diagnosis, disease investigation, and to do the bulk of the field evaluation of new vaccines or other prophylactics, there are four Veterinary Investigation laboratories each manned by at least three scientists and seven technical staff. Field evaluations of vaccines, drugs etc. are in the first instance done in one of the five veterinary research farms before being tried on farmers' animals. The veterinary farms are managed by technical officers.

Work at the main laboratory is organized in seven sections: virology, bacteriology, parasitology, pathology, chemistry/biochemistry, wildlife disease, and veterinary epidemiology and economics.

5.8.2.1 Virology Section

The major activity of the section is in research and development of vaccines. Among the vaccines produced for Kenya needs and export are those for Newcastle Disease and Fowl Pox for poultry, Bluetongue, Rift Valley Fever, Sheep and Goat Pox for small ruminants, and Rabies for dogs.

The laboratory is in the process of becoming a World Reference Laboratory for Rift Valley Fever. A major thrust of its research is in Arbovirology and the diagnosis and study of pox and other viruses.

5.8.2.2 Bacteriology Section

The main research is in the field of bacterial diseases of livestock including brucellosis and vibriosis. Interest in brucellosis is in preparation for a national program for the control of this disease which, apart from its being an important cause of infertility in livestock, is of major public health importance, especially in pastoral populations. Another interest has been in caprine pleropneumonia -- the leading cause of goat mortality in Kenya.

Poultry Salmonellosis has been a major activity of this laboratory for a long time, and research in Fowl typhoid and vaccine development is an active area in co-operation with the University of Nairobi. Monitoring of the pullorum-free status is maintained by the section whose efforts led to the eradication of the disease in Kenya many years ago.

The section runs a diagnostic service for the country and advises on appropriate treatments for bacterial diseases.

5.8.2.3 Parasitology Section

This is the largest section at the Laboratory, with sub-sections of acarology, helminthology, and protozoology.

The acarology sub-section is mainly concerned with research on the development of resistance in ticks to acaricides. It advises the government on the acaricides to use in the event of resistance being encountered with a given preparation. It has 4 scientists and 6 technical staff. The sub-section provides a continuous monitoring service to the government's massive tick control program.

The protozoology sub-section is engaged largely in trypanosomiasis research and has two foreign-assisted projects. The first, Walter Reed Project, is working on the pathogenesis of animal trypanosomiasis including aspects of immunology especially for closely related strains, infectious to both animals and man. The second foreign-aided trypanosomiasis project is on chemotherapy and its main thrust is to evaluate new preparations for effectiveness and safety, as well as monitoring the development of resistance to trypanocides in current use.

Co-ordination of trypanosomiasis services is done through the "Nairobi Cluster" referred to earlier in this report.

5.8.2.4 Pathology Section

This is largely a service section processing specimens for all the other sections. Specific research projects are conducted into the mechanisms underlying tissue damage during disease or due to toxic injury.

5.8.2.5 Chemistry/Biochemistry

This is another largely service-oriented section. Its functions are mainly in dip-strength analysis for the whole country and in toxicological studies.

5.8.2.6 Wildlife Disease Section

Because of the importance of wildlife in the country's economy and the tendency for farmers to blame wild game for the spread of livestock diseases, this section was set up to study the importance of game disease transmission. It has 4 scientists with diverse professional backgrounds (microbiology, pathology, parasitology) whose common interest and expertise is handling and study of wild animals. Apart from the study of these animals in the natural state, the section maintains stalls and a small farm stocked with various species of wildlife. The section collaborates widely with other laboratories and one of its scientists holds a staff position at ILRAD.

5.8.2.7 Veterinary Epidemiology and Economics

This is the newest sections whose function it is to collect data on disease incidence with the aim of studying disease trends and advising on possible control measures. When preventive measures are suggested, the section should advise on the most cost-effective control methods. The section is intended to monitor the performance of the government's disease control programs. This section is being further strengthened through the recruitment of an additional economist, 2 sociologists, a statistician, and the procurement of data processing equipment.

5.8.3 Other Veterinary Research Facilities

In addition to the above sections which are at the Veterinary Research Laboratories, Kabete, the Ministry of Livestock Development (research division) has a separate laboratory for research on Foot and Mouth disease, and four veterinary investigation laboratories.

5.8.3.1 The Foot and Mouth Disease Institute

This is a separate specialist laboratory at Embakasi on the eastern outskirts of Nairobi. Its staff of 6 scientists and 7 technical staff is engaged in Foot and Mouth Disease vaccine development. Work at the institute involves continuous monitoring of field viruses for serological shift and development of suitable vaccines to control new serotypes. The laboratory also offers routine diagnostic services for FMD for Kenya and other African countries.

Associated with the institute is an FMD vaccine laboratory jointly owned by the Kenya Government and the Wellcome Foundation, for the commercial manufacture of FMD vaccine. The laboratory has the capacity to produce up to about 40 million doses of vaccine (depending on the number of serotypes per dose) and until recently it was the only FMD vaccine manufacturing laboratory in Africa.

Vaccine produced by the commercial company is tested by the Government Institute for potency and safety.

5.8.3.2 Veterinary Investigation Laboratories

There are four of these laboratories in various parts of the country. Each is staffed by at least 3 scientists and up to 7 technical staff. The main function of these laboratories is to offer diagnostic services and carry out disease investigations and surveys. They are also

used for testing new disease control techniques in farmers' fields and are an important link between the research laboratories (both government and non-government) and the farmer. At the time of the team's visit, plans for building a fifth laboratory at the Coast were at an advanced stage.

5.9 Determination of Agricultural Research Programs and Priorities

By and large, the determination of agricultural research programs and priorities is carried out at the institutional level. Through current development plans and various documents, the government establishes the fundamental policies for research and development. These plans and policy papers may feature programs and projects, but they are generally in the form of brief general guidelines, with no specific priority status assigned to guide research in the event of inadequate resources to pursue all the planned programs and projects. The ministries, their institutes, research stations and scientists are normally expected to translate these policies and programs into feasible projects to meet the objectives, targets and aspirations of the government and the farming community.

The responsibility for the initiation and articulation of research programs lies mainly with the research station staff. Many of these staff are young and inexperienced and often lack inputs from a well-informed, organized farming community or extension service. Research station staff themselves often have to identify the research problems for their areas of responsibility, and, as the team found in many cases, may have no access to analytical and diagnostic approaches based on sound technical and socio-economic studies. In such cases, what emerges tended to be a collation of individual interpretations of (i) the mandate of the station and (ii) the problems of the farmers in the particular locality. Two committees, the Provincial Research Advisory Council and the appropriate Specialist Committee (commodity or subject), are expected, in principle, to make inputs into the elaboration of these programs. Some do, but the team saw no evidence of vigorous attempts to address program planning and priorities at these levels. The result is that, in nearly all cases, allocated funds and resources are spread over a large number of research projects, some of which may be unrelated to the major thrust of research and development for that area, and many of which cannot be adequately funded to generate the desired results. Some of the smaller research stations seem to be run on a maintenance basis rather than on a program and action-oriented research basis.

At the higher level of the ministry, the team saw no clear evidence of a sustained attempt either to establish program priorities or to relate priorities to the level of resources available. The ministries concerned are expected to seek and have access to the advice of the Agricultural Sciences Advisory Research Committee (ASARC) in making such decisions. The ASARC is still relatively new in the system, and the impact which it will have in the setting of program priorities is yet to be demonstrated. The responsibilities assigned to ASARC and the Board of Management of the research institutes should make them instruments for coordination and priority-setting in agricultural research programs. It is expected that the advice of these specialist advisory boards will be taken seriously in the decision to approve or not approve proposed research projects and that, in the case of limiting resources, programs and projects would be referred to them for further scrutiny in respect of priorities and relevance.

CHAPTER 6
ALLOCATION AND UTILIZATION OF RESOURCES IN AGRICULTURAL RESEARCH

The agricultural research system in Kenya has access to the physical, manpower, and financial resources built up during this century by the Ministry of Agriculture (including the Livestock Department), the various government parastatals, and the former East African Community. These comprise research buildings and laboratories in Nairobi, Kabete, and Muguga, plus about 40 national and regional research stations and sub-stations located throughout the country. Additional facilities exist at the Tea Research Foundation, Coffee Research Foundation, Agricultural Development Corporation, and the Government Boards in the country. University facilities for teaching and research also supplement research activities through their contribution to training of research scientists and the individual participation of staff in research programs of national interest (see Fig. 6).

Since Independence in 1963 there has been a continual build-up in the resources and facilities for agricultural research. By 1971, the agricultural sciences complex was estimated to be involving the nation in an expenditure of about K£ 13.9 million: K£ 3.57 million was allocated to agricultural sciences research and experimental development (R and D) and K£ 10.33 million to agricultural services. Some 599 scientists were involved (371 in R and D and 228 in services).

The national concern for the development of agriculture as a priority area, relative to other sectors, is indicated in the national expenditure on agricultural R and D and services. Agricultural research accounted for about 70 percent of the gross national expenditure on research and experimental development, and services accounted for 52.4 percent. Scientific manpower allocation to agricultural R and D was 65.2 percent of the total R and D scientists in the country, and 9.5 percent for services. For technicians the corresponding figures were about 50.7 percent and 54.9 percent for services. It is possible, as is the case today, that some of the assumed R and D expenditure was in fact not supporting research and development activities because many of the establishments were involved in a variety of service activities.

The physical facilities for agricultural research can be generally considered as adequate in scope, but not necessarily in quality. Many buildings and structures in the major research stations, such as NAL, Veterinary Research Department, Muguga, and other national and regional stations, are not functional because of a lack of infrastructural facilities and equipment. These resources can only play a full part in the research activities if they are adequately equipped and functional. A high priority should be placed in this area to develop the resources for research in the country's recurrent and development plans.

The overall picture of allocation, physical, human and other resources, is presented in Annex 10. The table indicates that resources are considered inadequate in 25 research establishments, and very inadequate in about 15. This is partly a reflection of the inadequacy of funding for the maintenance and operation of viable research programs in all stations and partly an effect of the limited resources being spread over too large a number of stations. Some of these research stations lack critical masses of staff to organize and execute research programs that

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are relevant to the problems of improving farmers' productivity. The tendency is to utilize these resources for holding purposes, keeping the station in a maintenance rather than a functional status.

The team was of the view that there are more research stations than can be adequately staffed and provided resources for them to be productive. The national research stations, in most cases, need large components of staff in various disciplines related to the major mandate of the station, the agriculture of their major commodities, and the farming communities in the area; most have major gaps in their multidisciplinary programs. The regional research stations require sizeable numbers of staff in the commodities and disciplines related to the development and trials of improved technologies to improve farmers' agricultural outputs in their regions. These were often not available, resulting in what appears to be a piecemeal approach to improvement.

The team believes that there is need for an internal exercise to review and rationalize the location of national and regional research stations. Some of them could easily serve as testing stations or sub-stations, managed by technical or intermediate level personnel with supervision and collaboration of research scientists from national or regional research stations. The team recommends that, in the present manpower situation, sub-stations should be managed by technical assistants and used mainly as testing and experimental sites. It seems wasteful of scarce, trained manpower resources to locate one or two young research scientists at sub-stations where they are likely to receive little or no guidance and where their chances of being productive are minimal.

It has not been possible to distinguish accurately between the financial resources made available by government sources to the various sections of agriculture, livestock development, and forestry and natural resources. There was also no easily accessible information on financial resources for agricultural research per se in university institutions and the private sector. University institutions are usually considered as educational institutions, and very little emphasis is accorded to their actual or potential role in agricultural research.

Data based on government estimates shown in Table 6.1 (next page) indicate a fairly satisfactory and consistent rate of expenditure on national research and development in the period 1977-1980.

Government allocation of funds for agricultural research comprises at least 70 percent of total funds for research and development. Considering that agriculture contributes about 35 percent of the GDP, the allocation of 0.35 of GDP may appear to meet the target of 1 percent of Gross Agricultural Domestic Product (GADP). However, the team believes that these funds could be more productive if there were a sharper focus on a limited number of programs and priorities that would be more likely to increase agricultural output and productivity -- rather than on the maintenance of a dispersed infrastructure and with a limited potential for immediate impact.

The effectiveness of the actual application of these funds in support of research is difficult to assess in the absence of detailed program budgeting. A relatively large workforce, with the ancillary service infrastructure, has been built up in most research stations. While such a facility may be an asset under adequate supervision by experienced research

Table 6.1. Total agricultural research expenditure¹ as percent of national research and development of GDP

Year	(A) GDP ² KSh Million	(B) National Expenditure On Research	(C) Expenditure on Agricultural Research ³	C/A ⁴	C/B ⁴
77/78	1640.65	8,279,410	5,726,292	0.35	69
78/79	1788.41	8,936,422	6,374,553	0.36	71
79/80	1974.97	5,905,032	7,010,672	0.35	74

¹Crops, livestock and range research

²GDP at current prices, based on economic surveys published by Central Bureau of Standards

³Based on government estimates of expenditure, excluding expenditure by private companies, self-financing institutions, and international institutions

⁴In percentages.

officers, enabling them to undertake several projects at a time, it has tended to distort the balance of research expenditure in many research stations where numbers of research staff have fallen below the critical mass. The situations at Mariakani, Matuga, Msabaha, and the Beef Research Station at Lanet are good examples. The recommendations on program planning and budgeting, and on the rationalization of research stations based on a study of the optimum number of research stations representative of the major areas of research development and agricultural output, should improve the effectiveness in the utilization of financial resources.

Table 6.2 (next page) presents data on the manpower and physical resources of the major national and regional research stations, with ratings of the adequacy of these resources. The general picture is one of inadequacy, even for modest agricultural research programs. It points to the need for additional resources for whatever number of stations is agreed to be optimum. The table also shows the type of support accorded to the national stations compared to the regional stations. As emphasis is moving from large farm systems to research on production systems for smallholders, the role of the regional stations becomes increasingly important. The need for some correction in the imbalance of resources and in the allocation of manpower and development resources and facilities is obvious. It is probable that the imbalance is partly caused by the location of national stations near major urban centres where it is easier to recruit and retain scientific staff. A system of special incentives in favor of the regional stations should be considered as an integral part of the overall improvement in the environment for agricultural research recommended in Chapter 9.

Table 6.2. Current distribution of research personnel and adequacy of facilities at major national and regional research stations

<u>National stations</u>	<u>Research officers (Kenyan)</u>	<u>Laboratory and office facilities</u>
1. NARS Kitale	26	Adequate
2. NSRS Kibos	9	Adequate
3. NPBS Njoro	21	Moderate
4. NAL Kabete	57	Moderate
5. NERS Thika	36	Inadequate
6. NDFRS Katumani	14	Grossly inadequate
7. NPRS Tigonj	11	Moderate
8. Coffee Research Foundation, Ruiru	18	Adequate
9. Tea Research Foundation, Kericho	4	Moderate
10. NAHRS Naivasha	8	Moderate
11. NRRS Kiboko	10	Inadequate
12. VRI, Kabete	56	Adequate
13. ARD Muguga	39	Adequate
14. VRE Muguga	20	Adequate
<u>Regional stations</u>		
1. WARS Kakamega	6	Inadequate
2. NARS Kisii	6	Inadequate
3. PHRS Molo	2	Inadequate
4. NARS Ol Joro Orok	2	Inadequate
5. ARS Embu	4	Inadequate
6. ARS Mwea-Tebere	8	Moderate
7. CARS Mtwapa	15	Grossly inadequate
8. AHRS Mariakani	1	Inadequate
9. CRS Kibos	4	Moderate
10. BRS Lanet	3	Inadequate
11. Irrigation R.S. Ahero	4	Inadequate

CHAPTER 7 AGRICULTURAL RESEARCH DELIVERY SYSTEMS

7.1 Ministries of Agriculture and Livestock Development

Although agricultural research is undertaken in various institutions and agencies in Kenya, the extension service is the main vehicle for transfer of agricultural research results to the farming population. The objectives of the ministries in promoting agricultural production through extension services are achieved through a network of extension staff at the national, provincial, district, divisional, sub-locational, and village levels. The Extension and Manpower Development Division is the largest of five divisions of the Department of Agriculture. The director of agriculture has major responsibility for the extension services, and he exercises this responsibility through the senior deputy director of agriculture (SDDA), the provincial directors of agriculture (PDAs), the district agricultural officers (DAOs), the divisional extension officers (DEOs) and the locational extension officers (LEOs). The LEOs are regarded as the front-line extension worker with the farmer (See Fig. 7).

Agricultural research results are delivered into this extension system through the interaction of provincial extension staff with staff of regional and national agricultural research stations. Such interactions take the form of joint tours and pre-extension trials, demonstrations, field days, formal and informal meetings, and published materials -- extension bulletins, newsletters, and recommendation leaflets. The Provincial Research Advisory Committee (PRAC) provides the interaction in research planning and feedback from farmers and the agricultural industry as a whole. The Agricultural Information Centre located at the National Agricultural Laboratories provides a channel for the transfer of research results to extension officers and farmers through various media including published materials, the press, radio, and television.

It is often said that the reasons for the gap between what has been demonstrated as technically feasible by agricultural research and the results obtained by farmers lie in the inefficiency of the extension services. On the other hand, the extension services charge agricultural research with developing and recommending improved technologies that have limited applicability in the farmers' situations. There is need for agricultural research to have and maintain greater awareness of the farmers' physical and socio-economic environment into which their improved technologies are expected to fit. The extension services need to interact more with agricultural research and the farmers in order to convey elements of requirements and improvements to both sides. Improvements in liaison between agricultural research and extension are considered and recommended in Chapter 9.

7.2 University and other Institutions

The university and other institutions involved in some aspects of agricultural research have no formal systems to take research results to the farmers. They depend on the network of the extension service. They also provide for interaction with extension officers, farmers, and other ~~research scientists through their open doors,~~ seminars, publications, demonstrations, etc. The university proposes to strengthen these systems

by organizing short courses for farmers and other primary producers and for the frontline extension workers. The agricultural extension units in these institutions may be expected to play a greater role in facilitating these interactions, perhaps in taking responsibility for some extension work in the immediate vicinity of the institution. Such involvements should create greater problem awareness by university research scientists and provide a feedback from farmers.

7.3 Communications and Information

Kenya, as has been shown, (Fig. 7) has an elaborate machinery for communication of research results to the farmers. At station level, field days are organized for the farming public to see and discuss new findings, materials, and recommended practices. For such occasions, an effort is made by research staff to produce and distribute simple pamphlets and information sheets written in English, Kiswahili, and, where possible, the major local languages. The material is also made available to the extension services for wider circulation.

A large number of farmers are either unable to read such material or to travel to the open days at research stations. An effort is being made to serve these farmers through recorded radio interviews with research staff, suitably edited for simplicity. The Ministry of Agriculture has also established an Agricultural Information Centre which is equipped to produce and disseminate literature, and cinema films depicting agricultural development activities and recommended production technologies.

In the last decade, a major effort has been made to forge a link between research and extension. Joint meetings are held regularly at the provincial level (PRAC), enabling closer exchange of ideas between research and extension personnel. Joint field tours are also undertaken in an effort to identify researchable problems and constraints. Although the numbers and level of training of the frontline staff are deficient, considering the size, diversity and distribution of the farming population, the greatest problems seem to be insufficient understanding of the priorities of the farmers and how these can be served with the resource constraints faced by the farmers.

CHAPTER 8
EXTERNAL SUPPORT FOR AGRICULTURAL RESEARCH

8.1 General

A number of donor agencies have assisted Kenya's agricultural research system, including multilateral and bilateral aid agencies, research and development agencies, and private foundations. Technical assistance has benefited research establishments under government departments, statutory research institutes, parastatal organizations, and the higher education sector.

Requests for technical assistance emanate in a number of ways, namely:

- (a) Government identification of subjects requiring research attention -- but which cannot be undertaken because of the lack of sufficient national capacity for undertaking such research;
- (b) Government desire to strengthen certain national research programs by injecting special expertise and equipment;
- (c) Major research undertakings, capital cost of which is beyond the national resources;
- (d) Development programs which cannot be successfully implemented without a research component which national resources cannot currently provide;
- (e) Training of Kenyan research workers on the job or in academic institutions to provide them with the expertise for research;
- (f) Provision of funds to enable scientists in the higher education sector to undertake research in their discipline;
- (g) As a result of a request by the donor agency to have its nationals acquire experience in tropical conditions;
- (h) Projects deemed by the donor agency to be beneficial to Kenya; and
- (i) Projects suggested by donor agencies with potential for application at regional or global level.

8.2 Multilateral Assistance

The principal multinational donors to Kenya's agricultural research systems have been the FAO/UNDP/, WHO, IBRD, and IAEA. The main research programs supported by these agencies are concerned with development projects. In a number of cases, the multilateral donor agencies pool resources with bilateral donors to finance certain research programs. Support by multilateral donors comprises provision of research personnel, equipment, and training fellowships. Donors rarely provide funds for local costs, which in most cases have to be provided by the ministries concerned.

8.3 Bilateral Assistance

Among other foreign countries which have supported Kenya's agricultural research system are included Canada, Denmark, Federal Republic of Germany, Netherlands, Norway, United Kingdom, and United States of America. Programs supported by bilateral donors are numerous, and the amount of aid ranges from a few hundred Kenyan pounds to well over KSh 100,000. The smaller amounts usually are for items of equipment, scientific visits, or training fellowships, while the larger amounts cover major research and development projects.

Bilateral assistance comprises technical personnel and equipment, but rarely provides funds for operating costs.

8.4 Foundations and International Research and Development Centers

In the period from 1963 to date, Kenya received aid from foundations and international research and development centers. Those identified as having assisted Kenya are the Committee for Technical Cooperation in Africa South of the Sahara, International Coffee Organization, International Development Research Centre, Leverhulme Trust, Nuffield Foundation, National Geographic Society, National Science Foundation, Ford Foundation, Rockefeller Foundation, and Wellcome Trust.

These institutions have supported numerous projects and they have been the major source of funds for research projects undertaken by individual scientists, especially from the institutions of higher education. They also provide support for small disciplinary projects dealing with specific agricultural commodities and animal health, diagnostic surveys, development of methodology, and for training.

Donor inputs into Kenya's agricultural research system have been substantial during the post-independence period. In most cases, aid is given where it is requested by the Government of Kenya, although this does not always work in practice. There are cases of projects that were undertaken only because donor funds were available, and there are projects that were not undertaken because donor support could not be obtained.

Data available for the mission indicated that for the period of 1963-1978, external technical assistance to agricultural research and related services amounted to K£ 18,841,000 which averages approximately K£ 1.2 million per annum. The numbers of project years supported were approximately as follows:

Crop research	155
Veterinary research	123
Animal production research	30
Pasture research	9
Others	12

A list of recent donor-assisted research and research-related projects is presented in Annex 11; this list cannot be regarded as exhaustive due to lack of documentation on some projects.

Kenya's agriculture has been benefited by programs of international and multilateral assistance through such bodies as the World Bank (IBRD), the UNDP, FAO, UNEP, and bilateral assistance from the United Kingdom (ODM), Federal Republic of Germany (FRG), Canada (CIDA and IDRC), The Netherlands, the United States (USAID), etc. In addition, regional and national programs of such international centers as IITA, CIMMYT, CIP, ILRAD, ILCA, ICRAF, and ICIPE, have assisted the national agricultural research system through collaborative research and training. The specific roles of the various organizations are briefly described and indications given of areas and means by which these various agencies and organizations could contribute more to the building of Kenya's national agricultural research capability.

8.5 The International Agricultural Research Centers (IARCS)

ILRAD, with its headquarters in Nairobi, has a major mandate for research in animal diseases. The two most important diseases in which its

research focuses attention, trypanosomiasis and east coast fever (ECF), are constraints of major significance to livestock production in Kenya. ILRAD maintains a close collaboration with veterinary and livestock research in Kenya. A "Nairobi cluster" involves the National Veterinary Labs (Kabete), the Veterinary Research Department, KARI, ILRAD, ICIPE/KETRI and others. It regularly discusses research collaboration and facilitates interaction. ILRAD's research on basic immunology of these two diseases is seen as a valuable complement to the work of the national institutions on vector and drug research. An active collaboration is involved in respect of the trial introduction of immunization procedures for ECF following an epidemiological survey at the Kenya Coast. This is likely to produce useful information in respect of the economic and environmental implications of ECF immunization in smallholder farming situations. Other aspects of ILRAD's activities strengthen Kenya's livestock research through training, conferences, (a recent one on theileriosis), research on trypano-tolerance and chemotherapy. ILRAD offers facilities for the other IARCs to operate in Kenya and for the benefit of Kenya's and other national programs for which they have responsibility.

ILCA has its main headquarters in Addis Ababa, Ethiopia, and maintains a number of other programs in Mali, Nigeria, Kenya, and Botswana. Its main focus in Kenya is in the study of livestock production, systems, the identification of constraints, and the development of techniques for monitoring livestock development projects. This focus covers animal production, range management, economics, sociology, and ecology, involving five international staff and five Kenyan staff. Collaboration is maintained with the Ministry of Livestock Development which is expected to follow up with intervention measures in the near future. Kenya will be expected to take over the program by 1983, but techniques developed will be useful in other semi-arid areas of Africa. Another major study is on trypano-tolerant livestock (cattle, sheep, and goats) in Africa. Carried out in collaboration with FAO, UNEP, and about 17 other countries in Africa, this study has led to the production of a major report on the productivity potential of trypano-tolerant livestock under different ecological, management, and nutritional conditions. Kenya has been selected because of the relevance of ILRAD's work and the opportunities of collaboration with UNEP, the Inter-African Bureau of Animal Resources, KETRI, ICIPE, KREMU, and other national research and development programs. Collaboration is maintained with the national livestock programs in other areas, including the evaluation of Boran, Sahiwal, and Ndama cattle, monitoring of performances on grazing blocks and ranches, development of productivity indices in range management, and censuses of cattle with low-flying aircraft. ILCA also offers valuable training to Kenyans in systems techniques in livestock production.

CIMMYT has maintained a regional program for eastern Africa, based on Kenya, for about 6 years. The main commodities are bread wheat, barley, durum wheat and triticales. Kenya offers an excellent research environment and unique opportunities for screening wheats for stem rust and stripe rust, for the identification of resistant lines for the highlands of eastern Africa, and for the identification of genetic materials for the breeding programs. The best lines identified from these programs are handed over to the Kenya national program at Njoro and to about 20 other countries from southern Sudan to southern Africa. CIMMYT's major responsibility has been seen in terms of the introduction

of new and improved germplasm, and a small team works with the national program at the National Wheat Breeding Station, Njoro. The national program in wheat improvement and agronomy is supported by a Canadian (CIDA) team of research scientists based at Njoro. This team carried out work in plant breeding, pathology, agronomy, etc., directly supporting and strengthening the national programs. Kenyans would like to see greater direct involvement of CIMMYT in the national wheat improvement program. CIMMYT sees its role more in the terms of introduction and rapid transfer of improved germplasm, the continuation of the work on disease trap nurseries, training (6 to 8 Kenyans were trained in Mexico in the last few years and some regional training workshops were held), and the strengthening of regional agronomic work.

A second major aspect of CIMMYT's work in Kenya is the regional economics program aimed at the development and promotion of farming systems relevant to small farmers. This program has demonstrated how these farming systems can be improved through the diagnostic studies, the systematic identification of farmers' priority problems, and the designing and evaluation of production technologies. This program takes place in collaboration with the Ministry of Agriculture. The Scientific Research Division (SRD) since 1977 has been assisted in building up socio-economics capability in research through in-service, formal, and informal training. Twenty Kenyan scientists (12 MSc and 8 BSc) were appointed in 1978 to fill positions in the national program, and some progress was made in the coordination of research with technical scientists on the research stations. The major constraint has been in the compartmentalization of disciplines and commodities, making it difficult to introduce systems analysis with socio-economic inputs. Not much progress has been made in the last one and a half years, but some attempts are now being made to interpose "adaptive research" between "technical research" and what is diffused by the extension services. The value of the shorter turn-around time of the diagnosis procedure followed by technical research has not been fully appreciated.

IITA has had a joint research program on cowpeas in Kenya with the Ministry of Agriculture and the University of Nairobi with Ford Foundation support. There have also been many Kenyans trained at IITA in crop production programs. In addition, IITA ran a seminar in Kenya on socio-economic surveys and has collaborated extensively on cassava, rice and to some extent on Farming Systems--in particular land management.

CIP is both a "source" research and "regional" research program in Kenya. The major aim is to develop the potato as a food crop in 22 countries of Africa, including Kenya. This is being achieved through the introduction and distribution of germplasm, transfer, adoption and adaptation of technology, seed and storage research, evaluation of germplasm for disease resistance (bacterial wilt, late blight), etc. Collaboration is maintained with Muguga and other institutions in research and development in the introduction and distribution of improved germplasm, and in training in the areas of storage, seed technology, tissue culture, etc. Seed and storage work with the ADCs, the Ministry of Agriculture and the Department of Agricultural Engineering, University of Nairobi (which are parts of Kenya's national program) have led to developments in commercial seed production, introduction of 2- to 5-ton storage structures, and evaluation of low-land tropical potato varieties for the Coast. The diagnostic surveys covering major aspects of production to marketing being carried out by economics graduates and

storage agronomists, and the training of national program staff in all these programs, are major contributions to Kenya's national program. The ultimate objective of the national program should be for the relevant research stations to be geared to provide innovative research ahead of farmers' practice. CIP can only provide a stopgap in research and offer training facilities to develop national capability in potato research. It is hoped that the national machinery will be utilized in defining and reviewing research priorities in potato work so that activities and projects can be launched that will take advantage of the momentum generated by CIP and the enthusiasm of the research stations.

ICRAF has its headquarters in Nairobi. Although it is not one of the centers in the CGIAR, it collaborates with the other international centers and programs in Kenya. ICRAF is funded by a number of international donor agencies and has its main focus in the research into land-use systems and farm-forestry research and development throughout the world. Major emphasis is placed on the improvement of tropical land-use systems through sustainable agro-forestry (including livestock). ICRAF's previous activities have been in research, documentation, education, and training. A major multi-disciplinary focus is now envisaged for research on the diagnostic studies of land-use patterns, role of trees, constraints in existing systems, and methodology of agro-forestry research. In addition, a number of projects are planned, and these will require direct field research in agro-forestry, coordination with relevant Kenyan ministries, and training of agro-foresters. Close liaison is being maintained with the Ministry of Environment and Natural Resources, the Forestry Research Department of KARI, the University of Nairobi, and other ministries in the planning and execution of research programs and in training in agro-forestry. Some documentation to support Kenya's land-use development plan is being built up and will be available soon. The major intention of the limited field project is to assist Kenya to train people to develop agro-forestry technology for land use in other areas of Kenya. Possibilities of joint research programs are also being explored, especially in relation to strengthening Kenya's activities in nurseries development, seed procurement, handling, and storage etc. Agro-forestry will have a major role to play in the development of the semi-arid and arid areas of Kenya into which food, fuel, and fodder production is likely to expand in the next few years.

ICIPE has its major focus in insect science. Its headquarters is in Nairobi, and its work is supported by an international consortium of donors. ICIPE undertakes some basic research on a number of insects of agricultural and medical importance; all are of significance to Kenya. The ultimate objective of ICIPE is to provide essential scientific information into the pest management systems for these pests and medical vectors. ICIPE's major strategy in building research capacity throughout Africa is expressed through its training program, which began in 1972. This has involved about 261 man years of training, and 70 to 80 percent of those trained have been Kenyans. The training program covers areas of graduate research, postdoctoral, technical, specialized groups (e.g. pest vector/management), and international study workshops and seminars. Collaboration is maintained with KARI, the Ministries of Agriculture and Livestock Development, University of Nairobi, and the IARCs. Programs such as studies on the basis of resistance to insect pests and on termites in semi-arid areas are of special significance to complementary

work in IARCs and the national programs. The training program is supported by only 4 to 5 percent of ICIPE's core budget, but agencies such as SIDA, WHO, UNDP, UNEP, among others, supplement training activities in areas of special interest and relevance. ICIPE plans to expand in the area of high-level scientific training and is proposing to introduce an international postgraduate course in insect science in collaboration with some universities in Africa soon. ICIPE should be able to make a major contribution to the training of Kenyans for research officer posts, as well as for the positions in some areas of technical and support services. The ICIPE facility is a Kenya-based resource of international standard capable of contributing to strengthening research and training in insect science in Kenya in the years ahead.

The international agricultural research and other centers discussed above are collectively making important impacts in strengthening Kenya's agricultural research system. They collaborate with many agencies of research in the public and private sectors and relate some aspects of their research work to Kenya's problems. It is important that the relevant parts of Kenya's agricultural research system should maintain interaction with these centers and draw on their resources of materials and knowledge in organizing their research and other intellectual activities. Although the area of direct involvement of international centers in national research programs will remain an area of possible disagreement for a long time to come, it is beneficial for the national program not to allow differences of opinion and/or approaches to affect their effective utilization of what is relevant to their own program. Because of its good linkages with other eastern and central African countries, Kenya should accept a leadership role as a choice regional center for research in crop and livestock improvement that may be of benefit to the other countries in the sub-region. A strong national agricultural research system would ensure that maximum advantage is taken of this leadership role in deriving benefit for the relevant components of national agricultural research. The IARCs would benefit from early involvement of the national scientists in the planning phases of their research work carried out locally. This variety and range of international programs and agency activities in Kenya should, in the opinion of the team, be of great benefit to a unified, comprehensive national research organization and a unified national research plan.

CHAPTER 9
FUTURE OF AGRICULTURAL RESEARCH: ANALYSES, CONCLUSIONS AND RECOMMENDATIONS

9.1 Structure, Organization and Management

Agricultural research in Kenya has evolved over many years. A variety of government and non-government organizations and agencies are involved now. The major ones include the Scientific Research Division of the Ministry of Agriculture (SRD), the Kenya Agricultural Research Institute (KARI), the Veterinary Research Department of the Ministry of Livestock Development, the Kenya Trypanosomiasis Research Institute (KETRI), the Tea and Coffee Research Foundations, and a number of parastatals such as the National Irrigation Board and the Agricultural Development Corporation (ADC). In addition, some relevant agricultural research is undertaken in the University of Nairobi faculties of agriculture, veterinary medicine and science, and in the programs of some IARCs that have regional or national cooperative programs in Kenya. The situation in June/July 1981 is summarized in Figure 5. There is not yet an effective mechanism for coordinating and controlling the spread of government-financed agricultural research to ensure efficient utilization of resources and to avoid duplication of effort. ASARC promises to fulfill this function with respect to advice on strategy and programs for agricultural research.

Kenya is heavily dependent on agriculture for economic and social prosperity. The agricultural sector has performed well in the first 15 years since independence. It is now under pressure to provide adequate food and improved nutrition for a population which is growing at an annual rate of about 4 percent, to generate more income locally and for adequate amounts of foreign exchange from exports, and to provide increased employment for a steadily growing work force. Several documents and reports demonstrate how difficult it will be to keep the rate of food production ahead of population increase, especially as many of the easier options for increasing production have already been used in the last decade. The Sessional Paper No. 4 of 1981, on National Food Policy, ~~further highlights this problem and suggests measures for~~ alleviating some of the difficulties. It is clear that future increases will have to come from both intensive and extensive utilization of the already limited resources, from further technological improvements in production techniques, and from the development of appropriate technologies for the utilization of medium-and marginal-potential areas of production. Similarly, the terms of trade are not consistently favorable for export crops, and progress must be made to cut costs of production further by improving productivity and the efficiency of production. Agricultural research has a vital role to play in this process, especially in relation to the small-farmer production systems and the ecological zones into which production must expand. It has been pointed out earlier (Chapter 4) that this will require a greater effort in research activity within the country, since fewer problems can now be dealt with by direct use of world knowledge than there was in the case of adapting technologies to large-farm agriculture in the high-potential areas. Resources for research are limited, and it is imperative that the best advantage be taken to organize and manage available resources to address the key issues.

In its visits, the team found an extensive research system that had developed to meet successfully a variety of demands over the years.

Those in the system were actively considering how to adapt to meet the demands of the future for more attention to small-farmer production systems and production in the drier areas. There has been a great deal of constructive thought, discussion, and action on a revised structure for agricultural research, spurred by the need to incorporate into the national system the former EAC research organizations. However, the major constraints to research efficiency and progress, emphasized by research stations personnel, were mainly operational; a severe shortage of trained staff, the frequent transfer of staff and the difficulty of retaining competent staff, and the problems raised by delays in procurement of research supplies and equipment (which often lead to frustrated scientists missing whole growing seasons for experiments).

The team also examined the organization, execution, and management of research through contacts, visits, and discussion at several institutions and stations. It sought to identify further the specific constraints that reduce research efficiency and output and to consider remedies and suggestions for ameliorating or removing these constraints. These further investigations confirmed the need for improvement in the structure, organization, and management of research, training of manpower, procurement procedures and financial administration, research planning and coordination, research environment, and the components of research activities. Improvement in the structure, organization and management of the agricultural research system was considered fundamental to the overall improvement in the performance, responsiveness and productivity of research. The resolution of this problem will go a long way in facilitating the resolution of the other specific problems and general constraints encountered or identified.

The team was convinced that the first and most important contribution to improving the service is for unification of the national agricultural research activities, which are now scattered in a number of publicly funded departments, agencies, and institutions, into a single service with its own management body but closely associated with the relevant operational ministries. The creation of such a functional, semi-autonomous, comprehensive, and cohesive organization -- charged with the responsibility for the planning, execution, and supervision of a coordinated, national agricultural research program -- was initiated in the Science and Technology Act (as amended in 1979), Chapter 250 of the Laws of Kenya, and in the establishment of the Kenya Agricultural Research Institute (KARI), as "a body corporate with perpetual succession and a common seal," with the functions to carry out research in the fields of agriculture, veterinary sciences and forestry, as well as do other things as specified in Section 14 (a)-(f) of that law (Annex 8) and in the Agricultural Sciences Advisory Research Committee (ASARC) established to plan and advise on agricultural research priorities. The team considers this a wise and appropriate action and recommends that urgent steps be taken to complete the actions initiated by this law. Furthermore, the Development Plan (1979-1983) Section 6.89 provided for "combining the research services of the Ministries of Agriculture (including the Ministry of Livestock Development which then was a part of Agriculture), and the Ministry of Environment and Natural Resources with the agricultural research services of the former East African Community - EAAFPRO and EAVRO (now KARI) - to form a new comprehensive agricultural research organization". The team considers this step as the logical evolution of a national agricultural research system from the disparate and diffuse agricultural research programs now spread over a number of

departments, agencies, and institutions. The team therefore strongly recommends the creation of such a comprehensive organization with a unified agricultural research service as fundamental to the strengthening of the national agricultural research system. For the purpose of legislative and administrative convenience the team proposes that the designation KENYA AGRICULTURAL RESEARCH INSTITUTE (KARI) be retained for the comprehensive organization. If, however, because of past association or identification with EAAFR0/EAVRO, Muguga, or for other reasons, the designation KARI is unacceptable, the team suggests the adoption of the designation KENYA AGRICULTURAL RESEARCH ORGANIZATION (KARO). The team emphasizes that the situation should not be seen or interpreted as that of the present KARI (which in effect is still a remnant of the old EAAFR0 and EAVRO) taking over all the research functions, stations, and responsibilities of the ministries; rather, it should be a mutually agreed amalgamation of agricultural research functions, programs, and projects under the comprehensive research organization (new KARI or KARO) with all parties to the integration playing significant parts in determining the focus, orientation, and priorities for national agricultural research.

The team found that the functions defined in the law for the Kenya Agricultural Research Institute are adequately comprehensive and that the provision for a competent semi-autonomous Board of Management, with well-defined responsibilities, provides sufficient guarantee for the efficient services, flexibility, relevance, and scientific quality expected of such an organization. The team observed that the board had been reluctantly compelled to interpret the functions of KARI in a narrow sense prior to the full realization of the concepts and responsibilities of KARI as envisaged in the law. The team is of the opinion that this interpretation of limiting KARI to residual EAC research activities and a regional research function in the Central Province is inappropriate and a retrograde step (see Section on KARI). The completion of the consolidation of KARI (or KARO) into a unified comprehensive research organization should remove this constraint and enable the new organization to develop and function responsively as the core of the national agricultural research system.

The team recognized the need for the new KARI (or KARO) to have close collaboration and interaction with the responsible Ministry of Agriculture and the Ministry of Livestock Development, as well as other participating ministries. The team therefore recommends that the directorate of the reorganized and consolidated research system should maintain close liaison with the ministries through a system of research liaison scientists as shown in Figure 1. The new comprehensive organization should, among other things:

- * be a semi-autonomous institution responsible for all agricultural research activities to provide information for the improvement of development and should assume responsibility for the operation of all agricultural, livestock, and forestry research stations;
- * serve equally the needs of the Ministries of Agriculture and Livestock Development and the development departments of the participating ministries and collaborate in research activities with all relevant ministries, being ready to respond rapidly to any emergency situation;
- * collaborate with different research organizations under the coordination of ASARC and the NCST;

- * establish and maintain a scientific research scheme of service that will provide appropriate terms and promotional prospects for staff based on research output and productivity;
- * participate fully in major discussions on relevant agricultural development policies and strategies.

Part of the reservations expressed in the past has been the fear that such a semi-autonomous, comprehensive research organization might be remote and unresponsive to the urgent development needs, aspirations, and programs of the ministries. The team believes that at this initial stage, it is preferable not to identify the new organization with the Muguga station, or with any national research station. This would enable its central role in the planning, execution, management, and supervision of agricultural research to emerge and be developed with salutary effects on the effectiveness, responsiveness, and the productivity of the research system. The team valued the opportunities to discuss these findings, conclusions, and recommendations with the Ministers and other authorities of the Ministries of Agriculture and Livestock Development towards the end of the mission.

The principal sectors in the agricultural research services are agriculture, livestock, and forestry. Traditionally there has been a further disciplinary separation in livestock into veterinary and animal production research. The team considers that, while continuing emphasis must be laid on the need for an integrated approach to an agricultural system incorporating all three aspects (as the farmer often does), the first logical division should have been into the above three sectors; disciplinary subdivisions should have come lower in the structure. Ideally, animal production and veterinary research should be combined into livestock research in both the unified research organization and the Ministry of Livestock Development. The benefits of achieving integration in animal production by combining these divisions are immense and should be explored in the evolution of the recommended comprehensive research organization.

Two new departments of the comprehensive research organization are recommended to strengthen the socio-economic and statistics inputs and the research/extension/farmer linkages. The team noted the recent trends in the introduction of socio-economic inputs into the identification of research problems and the planning, execution and evaluation of research projects. However, only few of the research stations have begun to implement this trend, due apparently to a shortage of trained agricultural economists. The team recognizes this need as crucial to the success and relevance of the research system and recommends the creation of a Department of Socio-Economics and Statistics at the directorate, as well as the strengthening of socio-economic inputs in the research work at all national and regional research stations. The details of the rationale for the recommended creation of the department follow.

9.2 Department of Socio-Economics and Statistics

The purpose of all agricultural research is to promote economic development and, in other ways, to improve the welfare of the population. There has been an increasing appreciation of the need for economic research to be integrated with or to parallel that in the agricultural/natural sciences and engineering. Such approaches are needed to identify more accurately researchable problems and to test and

interpret findings applicable to small farms. Socio-economic research is needed at successively more aggregative or macro levels as a basis for improving policies and the performance of rural institutions, so that socio-economic environment may become more conducive to improved performance by small farmers.

Various kinds and intensities of research are needed if ministries are to manage resources effectively for the sectors for which they have responsibility. A number of specific research areas are identified below with some indication of their content. It is proposed that these research activities be grouped in a separate entity of the comprehensive national agricultural research organization. This entity would be at par organizationally with the other departments and should be able to serve the research institute, the Ministries of Agriculture and Livestock Development and other ministries and, through publication, the general public. The entity could be called the Department of Socio-Economics and Statistics.

The variety of research activities required could be grouped in several ways, influenced by the combination of talents possessed by the personnel assembled. A possible grouping, which may be formally assigned to organizational units or merely allocated to individual staff within one unit at the outset, is the following;

a. Production economics and farming systems

This unit is to be concerned with the study of systems employed by small farmers, systems which are complex and require multidisciplinary efforts to gain a reasonable understanding of them. This means shoulder-to-shoulder efforts by economists, anthropologists, and several disciplines of agricultural sciences in the initial problem diagnosis; design of short-term or in-depth socio-economic studies; tests of new technologies for suitability with farmers' values and, if necessary, repetition of part of the sequence to fit the technologies more appropriately to farmers' needs.

b. Food supplies, demand, and consumption

This unit would assemble and constantly update comprehensive data on food supplies and their utilization. It would conduct studies of factors influencing demand and consumption of food as a basis for guiding policy makers on domestic production or imports. The unit's work would also involve nutrition and the influence policy changes may have on the populations' nutritional well-being.

c. Export commodities and foreign trade

This unit would conduct research on and keep abreast of international developments affecting demand and sales prospects for Kenya's agricultural export commodities and on imports of both food and agricultural producers' goods. The international export commodity economies would be studied closely in collaboration with production economists and marketing/pricing specialists to give guidance which would help assure optimum performance and growth.

d. Marketing, credit, and transportation

Constraints in these areas contribute to the current national food problem. Research could help policy makers and administrators plan courses of action to improve the environment in which farmers operate. Assuming results are effectively utilized, investment in research on this area would probably have a higher pay off than any other investment in agriculture.

e. Price and income analyses

Under controlled or reasonably free economies, price policies have

pervasive effects on producers, consumers, investors, and others. Research on these effects is needed as a basis for policy making and for projecting changes in production, consumption, storage, and foreign trade.

f. Statistics

Accurate and comprehensive statistics are the basis for a wide variety of useful information for research management. In concert with other expertise in the department, this unit should establish priorities for data collection. Collaboration with the Central Bureau of Statistics may accelerate efforts to enlarge and improve reporting activities on cropping areas, yields, total production and farmers' sales, farmgate prices, and wholesale and retail levels. Orderly reporting on marketing board operations, market receipts and storage also would be desirable. The unit would become the central depository for official time series on subjects to guide research and policy formulation.

The department could also contribute to the preservation of statistical series and other records, publications, and reports.

9.3 Department of Agricultural Extension Research Liaison and Communication

A second department is proposed in strengthening the structure and organization of the comprehensive research organization -- especially in the areas of research/extension/farmer linkages and communication flow within the research system: a Department of Agricultural Extension Research Liaison and Communication (Fig. 1). Such a department is considered an important input in strengthening agricultural research delivery and feedback systems.

The team observed during the visits to the research stations that many of the research staff knew little of the activities of other research stations in Kenya or elsewhere in the world -- even in their own field of interest. They expressed appreciation for the contents' pages and reprint service for scientific periodicals provided from the library at Muguga. Staff at all of the research stations admitted that linkages between the research scientists and the extension services were not as good as they should be.

The main objective of research is to provide information to a wide range of users. The efficiency of a scientist in a research station in Kenya is partly dependent on information reaching him from all over the world of agricultural research, as well as from scientists, farmers and producers in Kenya. He should be equally diligent in spreading and utilizing this new information and conclusions as efficiently as possible. Communication has become a science in itself. As it is at the core of the administration and management of an efficient and productive research system, it deserves to be given a special role in the national agricultural research system and service. Extra funds should be sought to achieve the better communication essential for the system. A smooth transfer of information between research and extension and farmers -- and within the research system itself -- is an essential complement to the organization and management structure recommended in this chapter.

Recognizing this need for effective communications, the team recommends that a special Department of Agricultural Extension - Research

Liaison and Communication be established within the comprehensive organization. The department would be responsible for communication of relevant information (a) within the research system, (b) between the research system, the extension services, and other user organizations, and (3) for feedback of problems from users to guide research. It is recommended that the present documentation service at KARI, the National Agricultural Information Center and the Kenya Agricultural Documentation Center (KADOC) in the Ministry of Agriculture be combined to form the nucleus of such a department. The new department should be strengthened, possibly through technical assistance, to fulfill the new role of communication, information, and training.

9.4 Determination of Agricultural Research Priorities

As indicated in Chapter 4, Organization of Agricultural Research in Kenya, the responsibilities for the determination of agricultural research programs and priorities are shared by a number of bodies in Kenya's present national scientific research system. These include the Ministries of Agriculture and Livestock Development (whose research and planning divisions are involved in the overall planning of research and development), and such organizations as the NCST, ASARC, and KARI -- with their committees and sub-committees. The NCST is involved through its advisory role in national science and technology policy, including policies in agricultural research, and both ASARC and KARI have specific roles in the planning and setting of priorities according to the Science and Technology Act which created both organizations.

The Ministries of Agriculture and Livestock Development provide the major resources for agricultural research. It is in their interest, and in the overall interest of the contribution of agricultural research to development, that their programs reflect national priorities in production. The ministries are structured to provide a general policy framework for agricultural research by indicating and translating government policies into general programs and priorities. The major instrument of the ministries for the determination of agricultural research priorities, especially in the case of competing claims on the resources for research, is the ASARC. ASARC is expected to advise the ministries on:

- (a) the details of the research programs and projects required to implement the research priorities arising from the national science policy;
- (b) the concomitant budget requirements of these programs and projects;
- (c) the coordination of research; and
- (d) the application of research results.

Functions outlined in Part III, Section 9 of the Science and Technology Act make ASARC a crucial committee in the determination of national agricultural research programs, priorities, and resources allocation. ASARC is relatively new, and its first annual report shows that it is just beginning to grapple with the problems concerning its functions. It is establishing a data base on which it can base advice to the agricultural research organizations.

The present system of program and priority determination appears to be largely ad hoc. The team saw no evidence of formal program planning for research at the headquarters. The station directors are encouraged to develop and carry out their research projects following the general guidelines of crop and livestock development policies and with the

assistance of program advisory committees. The young and often inexperienced staff of several of the research stations cannot be expected to translate these policies into sound, relevant research programs and to decide on priorities necessary to achieve the national goals of agricultural production. In many cases, therefore, the programs prepared by stations reflect only the assumed capability of staff and existing resources; they do not always show evidence of reorientation or focus in relation to national priorities, even when priorities are clear. The subsequent allocation of resources to stations do not therefore reflect the priority status assigned to programs. The tendency has been to utilize allocated resources to maintain existing programs rather than to make some of them more productive or to initiate new ones in the areas of national needs.

A number of committees play advisory roles to the research stations in the articulation of research programs. These include the Provincial (Agricultural) Research Advisory Committee (PARAC or PRAC), the Project Advisory Committee, specialist committees (commodity or discipline), and various ad hoc committees. While the inputs of these committees are considered valuable, there is no evidence that their views are well coordinated and taken fully into consideration at the level of approval of resources for the specific research programs.

In view of these antecedents, the team recommends that the determination of research program and priorities be based on wide consultations involving farmers, policy makers, research scientists, and senior research managers in the unified, comprehensive research system. Such consultations should make use of established committees. All should be reformed and provided with guidance to fit into a pattern that would make them useful advisory instruments to both ASARC and the unified, comprehensive research organization. They should convene regular national seminars on specific issues of major emphasis in research and review research plans and programs. Such seminars and reviews should involve senior scientists from within the national research organization, the ministries, the extension services, farmers, the universities and other national and international research and user organizations. The deliberations of such seminars and reviews, in brief forms, should be available to ASARC and other boards and government bodies involved in research policies and programming.

Both ASARC and the unified, comprehensive national research organization will play major roles in translating national research policies into programs and priorities under the guidance of their boards of management and expert committees. They will be required to make strong inputs into the articulation of research programs and the assignment of priorities. ASARC will need to consider and coordinate all research programs and projects formally in the light of the national science policy, development plan objectives, strategies and goals, policy documents of the relevant ministries, and resources available. Because of this monitoring and coordinating role, ASARC would also be in a position to advise on the continuation of programs and on concentrations of resources to achieve the national objectives of research. Even these roles will be expected to be exercised in consultation and collaboration with the comprehensive national agricultural research organization and the NCST.

The team recommends that the system of Program Planning and Budgeting (PPBS) be adopted as a policy for all approved research programs. Some technical assistance may be needed to train and assist in the introduction of the system. The system should make it possible to assess the utilization of resources in terms of research priorities and to ensure adequate resources first to programs of high priority when there is a shortage of resources. PPBS is useful to evaluate the performance and impact of specific programs in relation to the resources allocated to them and in relation to stated national goals. The stations should be encouraged to adopt the system for their projects.

As a follow-up to priorities setting and program planning for the overall and station research activities, the team suggests that detailed program planning should be adopted at each research station. This should involve a review of the experimental (crops and animals) programs between major seasons and close interaction between the directorate staff, the provincial and regional extension and research staff, and the research station staff. The objective of these reviews would be to maximize the use of limited manpower resources in priority programs and to facilitate any desirable uniformity in experimental design and results evaluation.

9.5 Criteria and Procedures for Determining Research Priorities

Numerous studies have shown that returns to investment in agricultural research are higher than most alternative development investments, assuming the research is properly focused, is efficiently conducted, and the results are utilized. The key words are "properly focused."

Leaders in every country aspire to general economic and social development. Location-specific research must play a part in the development process, but development itself is multi-faceted. To achieve overall development, it becomes necessary at some stage to reduce the relative proportion of resources utilized to procure food. Only in this way can resources be released to produce non-food goods and services or food for export sales. The country must develop relatively more purchasing power to procure non-food goods and services. Other usual objectives of development are to generate employment, broaden access to physical assets and other productive powers, and promote improved distribution of incomes, and improved levels of nutrition.

Research priorities must recognize the realities of the present stage of the development process and the time horizon over which results will be most applicable. The pressing need in Kenya at the moment is increasing food production for a rapidly growing total population (especially urban population). Kenya has limited comparative advantages in non-food lines that could earn foreign exchange to purchase food.

The farmer, the scientist, and the planner are key participants in identifying research problems. Any good scientist will be faced with far more important research problems than he can possibly address. The challenge is to ensure that his priorities are right and the projects are likely to have the highest payoff. There is no set formula for the planning bodies or the scientist to adopt. The following questions are important guides:

- (a) To whom is the problem important?
- (b) To how many is the problem important?

- (c) Who would be the users of results -- e.g., policy makers, other researchers, farmers?
- (d) How much benefit will the clientele receive if the problem is solved?
- (e) What is the likelihood that the research will contribute to a solution of the problem and in what time frame?
- (f) Are the research tools at hand?
- (g) What are the expected costs in money and time?
- (h) Why is the proposed area superior to some alternatives that might be undertaken with the same resources?
- (i) What are the expected costs of implementing results?
- (j) When would benefits begin to be realized and what would be their magnitudes?

Proposals from all scientists within a system usually give the integrated system a basis for setting priorities. This is often an insufficient basis if the staffs do not encompass all areas. In Kenya, for example, the need to economize on means of obtaining essential quantities of nutrients is shifting more to reliance on direct human consumption of crops. While both crop and livestock researchers would be able to contribute inputs to the rationale for allocating research resources between these two broad sectors, insights from detached and objective sources outside the immediate system would probably be important.

A clear articulation of the agricultural system and appropriate sub-systems aids the task of deciding priorities. This can be handled by simple diagrammatic models or by relatively sophisticated simulation models, some of which already exist for Kenya but are not being used. Overall models, coupled with sub-sector diagnosis, can help in identifying researchable problems. These can range from the simplest farming system to the complex sector servicing small farmers. Research on both can move ahead concurrently to permit small farmers to realize their full potential even with present technology. (An example can be cited in maize production in Kenya. Benefits of hybrid maize development of two decades ago are still not fully realized, largely because of ineffectiveness in the network of research and services to small farmers. These encompass provision of material inputs, research information, credit in many cases, and product pricing, marketing, and storage.) Through an aggregate systems model, results from a pilot area could be projected to a national basis.

At the small farm level, there is need for multidisciplinary applied research to identify constraints to farmers' adoption of improved technology and cultural practices. Without insights on these, the criteria enumerated above cannot be meaningfully answered.

9.6 Funding of Agricultural Research

Government-planned expenditure on research conducted in government-owned institutes and departments can, in some instances, be derived directly from the development plan. However, in most cases, research budgets are consolidated in the budgetary provisions of the technical departments of government ministries. In spite of what appear to be considerable resources devoted to agricultural research (approximately K£ 8 million in 1979-80 -- Annex 12), the budgetary procedures have not been modified to indicate clearly the planned and actual expenditures on agricultural research as distinct from

development. Research projects funded through the development budget, however, are shown as special entities. The team feels that the budgeting procedures should be modified to indicate clearly what the research budget is.

The team was able to deduce the plan period budgetary provisions in veterinary, range, animal production, crops and the joint research services (Muguga Station). These data were obtained from the final version of the draft development plan submitted prior to the publication of the Fourth Development Plan. See Annex 13.

Annex 14 indicates the trend in expenditure in agricultural research in the Ministries of Agriculture and Livestock Development; actual expenditures are shown for the fiscal years 1977-78 to 1980-81. These figures also indicate that the actual annual budgetary provisions are in line with the projections made during the formulation of the Fourth Development Plan. During the first part of the four-year period where actual expenditure is discernible, the research budget has grown at a satisfactory annual rate at current prices. (Nevertheless, it was felt that introduction of program budgeting as recommended would facilitate efficient utilization of funds on priority programs and projects.)

The projected research budget for forestry was not discernible in the development plan since it is completely incorporated within the operational budget of the Forestry Department. The expenditure indicated in the development budget for one project, the Marginal Lands Research, is an estimated K£ 396,000 over the five-year plan period. Forestry development programs for the period are projected to cost K£ 47,830,000. The share of research in the development budget appears to be 0.82 percent, but to this must be added the funding for forestry research through the Forestry Research Department of KARI and special projects at the University of Nairobi.

Research establishments supported by the industry through annual levies do not have forward budgets. There is no fixed percentage for research from these levies. Funds available for research therefore depend to a certain extent on the monetary value of the marketed commodity. When the output or value of the commodity falls, the research budget is reduced. Furthermore, there are no mechanisms for responding quickly to the needs for raising funds to solve problems of an emergency nature, such as was the case with the coffee berry disease.

The team is of the opinion that long-term budgetary requirements for industry-supported research establishments should be projected over periods coinciding with development plans. This procedure would facilitate better planning and utilization of research resources according to program priorities.

Donor support to agricultural research has been about K£ 1.2 million per annum over the last 16 years. A considerable proportion of these funds go to meet the personnel costs of expatriates. A large proportion supports specialist services in development programs. Only small amounts are expended directly on agricultural research.

The government 1980-81 and 1981-82 budgetary supports of K£ 4.6 million and K£ 6.0 million (recurrent and development respectively) for crops, and K£ 2.2 million and K£ 2.9 million for livestock (including

substantial research components) indicate increasing support to research at this crucial time (Annex 15).

During the team's visits to research establishments in Kenya, it was repeatedly stated that externally assisted projects have a heavy demand on counterpart funds and personnel. In order to meet obligations entered into with donor agencies, resources intended for important national programs have often been diverted or re-allocated to aid projects, some of different orders of priority. It would seem desirable that assistance project funds be made to fit into the approved priority programs; both ASARC and the new comprehensive research organization should be able to assure this.

Under Kenya's present economic circumstances, it is the view of the team that foreign donors should increase their assistance to Kenya, making assistance flexible to cover such complementary items as training, construction of laboratories, supply of scientific and operating equipment, vehicles, and some running costs.

9.7 Training for Agricultural Research

One of the major, and perhaps the most important, constraints in achieving greater efficiency and impact in agricultural research in Kenya is lack of adequately trained manpower. The shortage of manpower appears to range from the level of organization and management to that of execution of research projects and experiments in the field. Although Kenya has invested substantially in overseas training for agricultural research personnel in the last two decades -- and the University of Nairobi has made some impact in post-graduate training in recent years -- the country is far from achieving adequate manpower provision for agricultural research. The agricultural research system requires agricultural scientists who are well-trained in their own disciplines, who are sensitive to the wider technical, environmental, and socio-economic implications of research, and who could offer leadership in the articulation and execution of research programs.

The present situation is due in part to the inability of the research service to attract and retain staff. This factor, which stems principally from an unsuitable scheme of service, is discussed in the section on "Environment for Agricultural Research." A USAID report of September 1977 documented the loss of more than 58 research scientists, including 2 holders of the PhD degree, 23 MSc, 32 BSc, 1 BVSc and 4BSc with advanced diplomas, from a list compiled by the SRD three years earlier. It noted the disproportionately large number of young graduates, who lack research training and experience, in relation to the small number of excellent well-trained and dedicated research staff. A 50 percent turnover rate of staff at the NARS Kitale was given as a major cause of instability of maize research programs. Levels of recruitment are considerably below projected requirements due to training limitations and competition with the commercial sector for trained research scientists. This situation was in evidence during the present mission.

It is strongly suspected that the service has tended to lose many of its better professionals because of low grading and the associated salaries and conditions of service. The previous conclusion that the SRD has been used as a training ground for young graduates who then seek jobs elsewhere seems justified. Training is not the only solution to this

apparently intractable problem. Recommendations on training must be considered along with improvement of the general and specific environment of research if the agricultural research service is to attract and retain suitably trained research scientists.

The details of the present research manpower situation are given in Annex 10. Out of a total of 390 research scientists engaged, less than 15 percent have post-graduate or research-oriented training and qualifications that would fit them into the research and development functions to be performed. The team concluded from this and from other information that substantial efforts have to be made, and assistance sought, to embark on a massive and progressive training program over the next 10 years in various fields. A training program should be embarked upon immediately, with the mobilization of internal and external resources to expand higher level training at the University of Nairobi and assistance resources for other higher level specialized training overseas. The team did not define or assess the precise extent of training needs in relation to priority areas of research. It recommends that a study of specific manpower requirements and training needs be undertaken immediately, and a phased training program be worked out and embarked upon during 1982. The team feels that, in order to avoid the loss of valuable time, a minimum of 35 to 40 fellowships per year be tentatively sought and provided for in various fields during the next 5 years, starting with 1982.

The fields in which there appear to be the most acute shortage of research personnel are animal production, plant breeding, farming systems agronomy, agricultural economics, forestry, weed science, and science technology (equipment repairs and maintenance).

The team recommends the strengthening of the post-graduate programs in the faculties of agriculture and veterinary medicine, and relevant scientific disciplines in the faculty of science at the University of Nairobi. Special efforts should be made to implement the establishment of a joint Postgraduate School of Agriculture and Veterinary Medicine.

The team observed an acute shortage of animal production research personnel in the entire system. Few of the agricultural graduates have specialized in animal production despite the obvious need for animal production research and development. The team was informed of a proposal to introduce a BSc program in animal production with an intake of 50 students per year. Such a program would require staff development programs for both faculties, an improvement in the staffing situation, and substantial external support.

The team noted with satisfaction the expansion of the training facilities for agricultural research support staff at the diploma level at Egerton College. It recommends that these efforts be further pursued and strengthened to provide adequate numbers of this essential manpower for Kenya's agricultural research and development. The team further recommends the expansion and strengthening of training facilities for the agricultural research support staff at the agricultural institutes at Embu and Bukura and at the animal health and industry training institutes (AHITI). The team recommends further that the implementation of additional training institutes proposed, e.g., the Coast Agricultural Institute, be accorded greater priority and that relevant programs for the training of research support staff in the polytechnics and college of technology be strengthened.

The need for training in nearly all lines of research in agriculture, livestock, and forestry is so massive that all avenues for personnel development should be utilized. The following are suggested in the present context. These are not necessarily in order of importance and may be further updated by the proposed feasibility study.

- (a) On-the-job training.
- (b) In-service training.
- (c) Non-degree training leaves (mainly in IARCs and other relevant overseas institutions).
- (d) Some degree of specialized training in the BSc programs.
- (e) Expansion of first degree training (BSc) in Kenya.
- (f) Expansion of MSc training in Kenya and overseas.
- (g) Expansion of PhD training locally and overseas.
- (h) Expansion of intermediate-level training.
- (i) Introduction and development of research management training.

These avenues are applicable in all fields of agricultural research and should be pursued concurrently.

Training needs in forestry are also substantial. A department of forestry established in 1977-78 at the University of Nairobi initiated training with 16 students. It more recently restructured its program to provide professionals with training relevant to Kenyan conditions, including training in wildlife management. The number of trainees in the three-year program for 1981-82 is expected to be 60 for forestry and 15 for wildlife management. This will increase to 75 and 30 (intakes of 25 and 10) in 1983-84. (A recent FAO study of manpower requirements estimated current needs of 102 professionals and 487 technicians, not accounting for the massive Rural Afforestation Scheme and the development of the research sector.) Forestry approaches in the semi-arid areas emphasize the urgent need for both professional and technical level training far in excess of the present training resources. Professional manpower requirements for the entire forestry sector, including research for the period 1981 - 1990, are presented in Annex 17. They emphasize the need for support for both undergraduate and post-graduate development and expansion. The team notes that some support is already available to the universities through the World Bank Faculty of Agriculture Development Program and through Finnish aid. These assistance sources require considerable strengthening in the next five years.

All technical-level training certificate and diploma in forestry presently takes place at the forestry training school, Londiani. The school cannot meet the demands for technical manpower for the forestry service, with the development of rural afforestation, and semi-arid land schemes. The team recommends the re-introduction of the diploma in forestry at Egerton College (the diploma was discontinued in 1968). The team strongly supports the proposal to reactivate and strengthen the Nakuru technical training program in forest industries, wood technology, efficient use of fuel wood, charcoal production, and saw milling; it recommends this as a priority training activity meriting bilateral or multilateral support. Annex 18 summarizes the forestry research needs for developing countries, most of which apply to Kenya.

The agricultural research system needs experienced staff who are trained in Research Management to provide leadership in the divisions, departments, and programs of the proposed comprehensive organization and in the national and regional research stations. The team recommends that assistance should be sought to train about five senior scientists a year

in research management over the next five years. Arrangements should be made for in-service training courses of shorter duration for other directors and officers-in-charge of research stations. The team noted and fully endorses the current proposals by NCSI to initiate some in-country training in research management in collaboration with IDRC. Such a program would benefit Kenya and some of the neighboring countries with similar needs for training in research management. Training is also required for technicians and technologists in repair and maintenance of scientific equipment. Such training will call for assistance from developed country suppliers of equipment and should feature practical training and exposure in use, maintenance, fabrication, and repairs of equipment in scientific institutions. The team recommends that quotas of fellowships should be negotiated in this special area with the United Kingdom, United States, Federal Republic of Germany, and Japan, as the major suppliers of scientific equipment, with the possibility of supplementary training in other countries as required.

The team considers training as the most important input in strengthening Kenya's national agricultural research system. A planned program of consistent training over the next 5 to 10 years should remove this most important constraint to the planning, execution, and transfer of agricultural research. It should strengthen the national research capability for generation, adaptation, and adoption of improved technologies for increased agricultural production.

9.8 Environment for Agricultural Research

Investments in the training of agricultural research personnel, the establishment and equipping of research institutions, and in facilities themselves do not guarantee an effective research system. More than the basic facilities are important in ensuring that qualified research staff are attracted, retained, and made productive in a national agricultural research system.

It has been estimated that the average length of employment in the research division of the Ministry of Agriculture has been 2 1/2 years for Kenyan personnel and 3 1/2 years for expatriates. Of 78 members of staff at BSc or higher training in service in 1969, six remained in the system by mid-1981. Losses have been to other units of government, universities or colleges, and the private sector. Of 188 members of staff in 1974, 58 had resigned by 1977. By mid-1981, the research divisions of agriculture and livestock development had a service staff of about 390 -- 341 had BSc degrees, about 41 had MSc degrees, and 8 had the PhD. These numbers are deployed among more than 40 research stations and sub-stations throughout the country. Twenty-one stations have five or fewer officers, and only four more than 10. This suggests a problem of lack of critical mass for desirable multidisciplinary research.

A productive overall agricultural research environment has many facets. The most important factors include the physical, social, remunerative, organizational, management, and intellectual conditions under which the research personnel work. A number of "environment" issues can be noted. First, the agricultural research scientists and their role in national agricultural development lack recognition. Second, the research cadre receives less remuneration than people with comparable training and experience in other components of the agricultural sector. Third, the present scheme of service does not

provide for scientific career development, recognition and reward for research productivity. Advancement is based mainly on administrative or management responsibilities instead of research responsibility and productivity. The Civil Service personnel classification system is not suited to the career line of a creative research scientist. Irrespective of performance, an individual may require 15 years to reach the level of senior research officer (a third category post). In order to advance further, he has to become an assistant director or director of a major research station, moving in an administrative or management system. There are other rigidities: the two top positions (assistant director and director of research) are fixed scientific administrative posts; the lower posts of senior research officer are subject to establishment, and are available only to heads of sections or officers-in-charge of stations. In contrast, the Coffee Research Foundation and at least two research institutes created under the Science and Technology Act are reported to have applied a scheme of service that places emphasis on research functions and not on management. For agricultural research scientists, the team firmly recommends the adoption of the scheme of service that is understood to have been approved by the office of the Director of Personnel Management. The scheme includes these positions and job group classifications:

- | | |
|------------------------------|----------------|
| - Assistant research officer | Job group J |
| - Research officer | Job group K, L |
| - Senior research officer | Job group M |
| - Principal Research Officer | Job group N |
| - Chief research officer | Job group P |

This scheme of service provides for upward mobility of research personnel without the assumption or imposition of management or administrative duties. The team considers the adoption of this scheme of service as a fundamental issue in creating a favorable environment for research.

The agricultural research system should offer an improved physical, social, cultural and intellectual environment for its research personnel in addition to recognition, remuneration and opportunities for advancement. In many cases the physical facilities in the research stations and laboratories are inadequate. There is a need to provide improved field and laboratory space and equipment for some of the stations (see Annex 10), and financial resources in terms of running costs should be adequate and be released in time for scheduled research projects. Attempts should be made to improve the living conditions and infrastructure on most of the research stations and sub-stations. A detailed internal exercise should be undertaken as early as possible to assess the realistic needs of stations and sub-stations as an integral part of the completion of the on-going reorganization. The overall environment should take into account the rest of the scientist's family and opportunities for children's education, housing, etc.

Among the important intellectual facets for a favorable environment is the opportunity for advanced training, scientific interaction, and self-development. The training requirements, including in-service training, have been dealt with earlier in this Chapter. In addition, provisions should be made for scientists to participate in national and international workshops, seminars and conferences. Special consideration should be given to the young, inexperienced scientists as it is through such interactions that self-confidence is built and opportunities for self-assessment are realized. The team feels strongly that early attention to what can be done internally to improve the overall

environment for research will go a long way in ensuring the stability of the agricultural research service during this critical period.

9.9 Agricultural Research Results Delivery System

The recommended structure, organization, and management of the new comprehensive research organization envisages the establishment of a Department of Agricultural Extension Research Liaison and Communication. The problem of isolation of the agricultural extension services for agricultural research in the SRD and KARI was recognized as far back as 1978 (in the appraisal of the first World Bank Integrated Agricultural Development Project.) The "Bridge-the-Gap" conference of April 1978 identified a dozen reasons for strengthening crop research, which are documented in the World Bank Staff Appraisal Report of November 1979. IADP II now has the objective of strengthening its research base and the links between SRD, KARI, and the extension services. The recommended linkage system is of the highest priority in view of the tendency for research scientists everywhere to concentrate on their research work and pay less attention to the utilization of the results. A department, made up of agricultural scientists competent in the area of extension education, mass communication, behavioral sciences, home-economics, socio-economics, as well as agricultural subject matter specialists, would ensure constant interaction with the extension services and the agricultural industry. Important constraints in the agricultural systems would be identified, areas of researchable problems would be defined and brought to the attention of research scientists, and the impact of improved technologies would be assessed through farmer situations. The department would provide a point of contact of research with the extension services and the users of research results. Such a department could also, with the cooperation of the research scientists, organize training workshops and seminars to expose different levels of extension officers to new techniques developed in research. It is suggested that the present Agricultural Information Center at NAL and the Kenya Agricultural Documentation Center become a part of, or establish a strong working relationship with, this Department of Agricultural Extension Research Liaison and Communication (AERLC). The mission strongly recommends that this Agricultural Extension Research Liaison and Communication Department be established within the research organization and that facilities be provided for it to ensure an adequate flow of communication, training, and information within, into, and from the recommended agricultural research system.

The team noted that excellent work is being carried out now by extension services in the Ministries of Agriculture and Livestock Development. It recommends that the services should continue within the Ministries, but closely linked with the Department of Agricultural Extension Research Liaison and Communication. Attempts should be made to strengthen the services in terms of their coverage of districts, divisions, locations, and sub-locations and in terms of the quality of staff. The team emphasizes the need for regular in-service and refresher training for the junior, intermediate, and senior personnel. Opportunities should be utilized for production training and other courses offered by the IARCs and other international or regional programs. Where appropriate, opportunities should be offered to junior and intermediate officers to take professional courses that would qualify them for positions in the higher echelons of the extension services.

9.10 Other Requirements for Strengthening the National Agricultural Research System

At independence Kenya inherited a sizeable network of agricultural research stations and has continued to expand this network into new areas of agricultural production. It has not been possible to expand the cadre of local trained scientific and technical personnel to meet the increased demand. This remains the greatest obstacle in the efficient utilization of present research resources. A two-pronged approach of (a) technical assistance personnel and (b) accelerated training programs has been used to solve this problem, but the simultaneous expansion of the agricultural development sector without a commensurate training program has tended to negate efforts to build up a research cadre for the large network of government research stations. A main technical requirement for strengthening Kenya's agricultural research system is an immediate injection of qualified personnel who could lead training for young graduates entering the profession. Lack of such guidance and support has been instrumental in the loss, through despair, of good potential scientists. In the course of expansion of the scientific staff, adequate amenities and supporting facilities will need to be provided.

Another important requirement is the development of a cadre of research managers with enthusiasm and skill in administering a scientific staff. The present system, which provides management as the only promotional outlet for research scientists, is detrimental to the research in that it encourages some good scientific staff to turn into less effective research managers. A career structure is needed which facilitates parallel development along research or management lines. Even then, a special program should be initiated to enable directors of stations to widen their experience and develop managerial skills. The team noticed that stations with more experienced directors tended to have a more stable staff and well-articulated programs.

Well-trained technical support personnel are also required. It is a waste of resources for good scientific equipment to stand unused because the station has no technicians to carry out routine maintenance and simple repairs.

Scientific programs can lose direction or cease to be productive if they are not subjected to thorough periodic reviews. The pool of experienced scientists in Kenya who can conduct such reviews is limited at present. This problem could be eased through a program that provided the services of competent scientists from the international scientific community, preferably on an exchange basis.

The team noted that the treasury officials were usually sympathetic when a good case could be made for research expenditure. In many cases, however, a serious deficiency in budgetary procedures leads to severe shortfalls in some of the more active programs and to continuation of funds in other cases, despite their diminishing absorptive capacity. Some research directors had not submitted estimates in some years. They argued that their eventual allocation of funds bore no relationship to their estimated requirements.

The main aspect of financial management by the Research Director ensures that funds allocated are utilized in the prescribed manner. Upper limits on what can be purchased directly (Sh.1000/-), by local

quotation (Sh.4000/-) and ministerial tenders boards (Sh.200000/-) are the same for all government departments. In the team's view, the expenditure limits are set far too low. The many steps needed for tendering for purchases at the ministerial and central tenders board are the most serious constraint to the efficient procurement of goods and services for research.

A second serious constraint to the procurement is the centralized payment system. Payment vouchers from all over the country are processed centrally, and no distinction is made to assure immediate payment of certain bills. The result is frequent interruptions in the supply of goods and services due to delays in payment. Decentralization of the system to enable research units to directly pay for goods and services would alleviate the problem.

Although the development budget for research has grown considerably in recent years, the recurrent budget is unlikely to increase in real terms at a rate sufficient to maintain the new developments and to expand absorptive capacity. The agricultural research system will need both additional funding and introduction of program budgeting to facilitate proper allocation of resources. The team noted further that the capacity of stations to utilize funds is reduced by either the lack of foreign exchange elements, in the case of imported equipment, or by cumbersome procurement procedures. The team recommends that greater autonomy be granted to directors of research stations in the expenditure of approved funds within the framework of government accountability. The administrative and accounting staff of the organizations would be needed.

CHAPTER 10
FOLLOW-UP ACTION

The present study has been a collaborative effort between ISNAR and the NCST, Kenya -- as an agent of the Government of Kenya in the field of scientific research for agricultural development. If Kenya is to strengthen its agricultural research system to meet its needs, the Government will need to take action on the major recommendations in relation to: organization and management of the research system; training of manpower; improvement of the research environment; improvement in procurement procedures for research goods and services and in financial administration of research activities; strengthening of socio-economic inputs in research and stronger research orientation to the small farmers; and the strengthening of research/extension/farmer linkages through an Agricultural Extension/Research Liaison and Communication Department; and other measures. The Government may wish to consult with ISNAR on follow up of the recommendations once its decision has been reached.

Time did not permit the team to specify in detail the areas and specific emphasis of the massive training requirements necessary to strengthen Kenya's agricultural research system. It is recommended that, as a matter of urgency, a feasibility study be undertaken to identify and quantify Kenya's specific training needs (numbers, areas, levels, phasing, duration, etc.) over the next 5 to 10 years. Such a study should be undertaken promptly, with a report as early as possible in 1982 for implementation later in the year or in 1983. However, as an interim measure, it is recommended that immediate assistance be sought in obtaining 35 to 40 fellowships to initiate manpower training program in the areas identified as critical -- so that some training could commence in 1982.

Other areas in which it is recommended that action proceed while undertaking further study and consultation are:

- (a) Seeking, through technical assistance, the services of two competent persons to assist the comprehensive research organization in its research management, research planning and budgeting system. These services would also be available to ASARC and to the ministries in their implementation of other relevant recommendations.
- (b) Seeking technical and financial assistance in setting up a new Department of Socio-Economics and Statistics in the new research organization and in training and providing leadership for headquarters and field activities of the new department.
- (c) Seeking technical and financial assistance in establishing the new department of Agricultural Extension/Research Liaison and Communication as a linkage mechanism in the agricultural research delivery system.

The team believes that the development of a consortium of donors, with interests and expertise in the areas of organization and management of research systems and training of research manpower in agriculture, livestock and forest resources management, to assist Kenya in strengthening these specific areas, would be most helpful. If desired by the Government of Kenya, ISNAR could be requested to assist in the possible formation of such a consortium.

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The follow-up action proposed to strengthen Kenya's agricultural research system will be a long-term activity involving careful planning. As noted above, the first requirement, however, is for an early decision by the Government as to how it wishes to proceed with this follow-up action.

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A N N E X E S

OFFICE OF THE PRESIDENT

Telegrams: "SCIENCEKENYA", Nairobi
 Telephone: Nairobi 306173
 When replying please quote
 Ref. No. NCST/SEC/8603.1
 and date



NATIONAL COUNCIL FOR SCIENCE
 AND TECHNOLOGY
 P.O. Box 30623, NAIROBI
 KENYA
 ...13th. March,, 1981..

Dr. W.K. Gamble,
 Director General,
 I.S.N.A.R.,
 P.O. Box 93375,
 The Hague,
 Netherlands.

Dear Dr. Gamble,

STRENGTHENING OF KENYA'S AGRICULTURAL RESEARCH SYSTEM

During his visit to Kenya in March 1981, Professor Ajibola Taylor of ISNAR, Professor Gacii, Secretary to the National Council for Science and Technology, and other Kenyan officials representing various agencies in the agricultural research system, held discussions on possible ISNAR/NCST collaborative study aimed at strengthening Kenya's agricultural research system.

It has been agreed in principle that a study should be undertaken with the objective of identifying constraints, gaps and deficiencies of the agricultural research system in Kenya. The attached draft project document is being submitted to both ISNAR and NCST for consideration and approval.

On behalf of the NCST, I confirm that the study has our approval in principle and that it should continue as agreed. I also confirm that the NCST will meet its obligations contained in the draft project document.

Yours sincerely,

S.N. MUTURI
 for : SECRETARY, NATIONAL COUNCIL FOR SCIENCE
AND TECHNOLOGY

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Professor Peter Gacii
Executive Secretary
National Council for
Science and Technology
P.O. Box 30623
Nairobi
Kenya

April 1, 1981

Dear Professor Gacii,

Strengthening of Kenya's Agricultural Research System

I wish to acknowledge receipt of your letter of 13th March and the draft project proposal prepared by Professor Ajibola Taylor on behalf of ISNAR and yourselves.

I am pleased to confirm that the project proposal has the approval of ISNAR and we shall be very willing to cooperate.

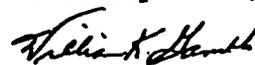
Professor Taylor will lead the team from ISNAR that will participate with Kenyan scientists in this study. He will keep you advised as to dates and details for the study and he and others are already busy in preparation of background information. We propose to have a 4-5 man team from ISNAR and for them to be in Kenya for the period approximately June 16 - July 17, 1981. As I will be travelling in Asia for all of April, kindly correspond directly with Professor Taylor if there are any matters requiring attention during this period.

I have dated the project proposal 30/3/81 and am returning to you a copy initialed by me for your records.

I look forward to a successful endeavor.

With best personal regards,

Sincerely Yours,


William K. Gamble
Director General

Encl.
WKG/as

INTERNATIONAL SERVICE FOR NATIONAL AGRICULTURAL RESEARCH

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The Itinerary of the Review Mission

Sunday, 21 June 1981

- Study team arrives in Nairobi.

Monday, 22 June 1981

- Meeting with the Executive Secretary, NCST, Prof. P. Gacii.
- Team Discussions on the Terms of Reference and Mission Procedures.

Tuesday, 23 June 1981

- Meeting with the Directors of Research Ministries of Agriculture and Livestock Development.
- Meeting with the Deans Faculties of Agriculture and Veterinary Medicine, University of Nairobi, Kabete Campus.

Wednesday, 24 June 1981

- Visit to ICIPE. Meeting with the Senior Training Officer.
- Meeting with the Director of Research, Ministry of Livestock Development (Kabete).
- Meeting with the Representatives of the International Agricultural Research Centres (ILRAD, ILCA, CIP, CIMMYT, ICRAF) at ILRAD Headquarters.

Thursday, 25 June 1981

- Visit to the National Agricultural Laboratories. Meeting with Director and staff.
- Visit to the Veterinary Research Laboratories, Kabete. Meeting with the Director and staff.

Friday, 26 June 1981

- Visit to the National Dryland Farming Research Station, Katumani. Meeting with Director and staff (including the FAO/UNDP Project Staff).

Saturday, 27 June 1981

- Visit to Kenya Agricultural Research Institute (KARI). Meetings with Director, Deputy Directors (Crop Production, Animal Production, Forestry and Veterinary) and staff.

Sunday, 28 June 1981

- Travel to Naivasha.

Monday, 29 June 1981

- Visit to the National Animal Husbandry Research Station, Naivasha. Meeting with Director and staff.
- Visit to the National Seed Quality Control Service, Lanet. Meeting with Director and staff.
- Visit to the Beef Production Research Station, Lanet. Meeting with Director and staff.

Tuesday, 30 June 1981

- Visit to the National Plant Breeding Station, Njoro. Meeting with Director and staff.
- Visit to Egerton College of Agriculture, Njoro. Meeting with Principal and staff.
- Travel to Kericho.

Wednesday, 1 July 1981

- Visit to Tea Research Foundation, Kericho. Meeting with Director and staff.
- Visit to Nyanza Agricultural Research Station, Kisii. Meeting with Director and staff.
- Part of the Team (HM and SC) visits Livestock Research Stations and Veterinary Investigation Laboratories in the Kericho area.
- Travel to Kisumu.

Thursday, 2 July 1981

- Visit to Rice Research Station, Ahero. Meeting with Director and staff.
- Visit to the Ahero Pilot Project.
- Visit to the Sugarcane and Cotton Research Stations, Kibos. Meeting with Director and staff.

Friday, 3 July 1981

- Visit Western Agricultural Research Station, Kakamega. Meeting with Director and staff.
- Travel to Kitale.
- Visit to National Agricultural Research Station, Kitale.
- Meeting with Director and staff.

Saturday, 4 July 1981

- Visit to National Agricultural Research Station, Kitale - continued.
- Visit to Kenya Seed Co. Ltd., Kitale. Meeting with General Manager and staff.

Sunday, 5 July 1981

- Travel to Nairobi.

Monday, 6 July 1981

- Preliminary review of progress of review. Contacts and consultations with Ministries and officials.

Tuesday, 7 July 1981

- Visit Coffee Research Foundation, Ruiru. Meeting with Director and staff.
- Visit National Horticultural Research Station, Thika. Meeting with Director and staff.
- Part of the team visits Ministry of Environment and Natural Resources. Meeting with Director of Forestry.

Wednesday, 8 July 1981

- Visit Embu Agricultural Research Station. Meeting with officer-in-charge and staff.
- Visit Cotton and Rice Research Station, Mwea-Tebere. Meeting with officer-in-charge and staff.
- Part of the team visits Department of Forestry, University of Nairobi. Meeting with Head of Department and staff.
- Travel to Nairobi.

Thursday, 9 July 1981

- Travel to Mombasa, Coast Province (by air).
- Visit Coast Agricultural Research Station, Mtwapa. Meeting with officer-in-charge and staff, and staff from associated stations, Matuga, Mariakani and Msabaha.

Friday, 10 July 1981

- Visit to the Provincial Director of Agriculture. Meeting with Director and staff.
- Part of the team visits Livestock Research Stations in the Coast.
- Preliminary discussions of findings.

Saturday, 11 July 1981

- Travel to Nairobi.

Sunday, 12 July 1981

- Preliminary discussions on the findings in relation to Forestry.

Monday, 13 July 1981

- Travel to Nakuru.
- Meeting of the Review Mission on Draft Report.
- Drafting of Preliminary Report.

Tuesday, 14 July 1981

- Drafting of Preliminary Report.

Wednesday, 15 July 1981

- Drafting of Preliminary Report.

Thursday, 16 July 1981

- Travel to Nairobi.
- Contacts and official consultations.

Friday, 17 July 1981

- Drafting of Preliminary Report.
- Discussion of major findings.

Saturday, 18 July 1981

- Drafting of Preliminary Report.
- Discussion of major findings and conclusions.

Sunday, 19 July 1981

- Review of major findings and conclusions.

Monday, 20 July 1981

- Meeting with the Executive Secretary, NCST, Permanent Secretaries and Directors of Agriculture, Livestock Development and Forestry. Presentation and discussion of major findings, conclusions and recommendations.

Tuesday, 21 July 1981

- Meeting with the Minister of Livestock Development. Presentation and discussion of conclusions and recommendations.
- Meeting with Chairman, Board of Management of KARI and Director of KARI. Presentation and discussion of major findings, conclusions and recommendations.
- Meeting with the Director of KETRI.

Wednesday, 22 July 1981

- Meeting with the Minister of Agriculture, Permanent Secretary and Deputy Permanent Secretary, Director of Agriculture and Director of Research.
- Presentation and discussion of major findings, conclusion and recommendations.

Thursday, 23 July 1981

- The Review Mission ends. Members disperse.

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GROSS DOMESTIC PRODUCT BY INDUSTRIAL ORIGIN . 1974-1979
At Constant (1976) Prices

	KE million					
	1974	1975	1976	1977	1978	1979 ⁺
Gross Product at Factor Cost						
A. Traditional Economy						
Forestry	8.80	9.11	9.40	9.88	10.04	10.32
Fishing	0.23	0.23	0.29	0.30	0.34	0.36
Building and Construction	20.85	21.28	21.86	22.71	23.32	24.00
Water	8.63	8.79	8.90	9.41	9.56	9.84
Ownership of Dwellings	27.02	28.17	29.36	30.59	31.86	33.17
Total Product Traditional Economy	65.53	67.58	69.81	72.89	75.12	77.69
B. Monetary Economy						
1. Enterprises and non-profit Institutions						
Agriculture	425.36	458.38	466.15	513.60	533.31	529.05
Forestry	6.48	5.76	5.24	6.72	6.94	7.17
Fishing	1.91	1.90	2.36	2.36	2.75	3.00
Mining and Quarrying	2.74	3.11	3.41	4.05	4.14	4.52
Manufacturing	144.90	145.77	144.18	167.10	188.16	201.56
Electricity and Water	11.59	12.76	14.20	16.42	17.82	19.57
Building and Construction	48.98	47.12	45.22	49.34	55.26	60.29
Wholesale, Retail Trade, Restaurants and Hotels	141.53	136.21	132.54	143.59	155.92	154.36
Transport, Storage and Communications	64.52	62.59	69.15	73.74	81.40	87.26
Finance, Insurance, Real Estate & Business Svs	59.23	62.84	68.03	71.98	77.59	81.31
Ownership of Dwellings	54.21	56.70	58.06	60.48	62.49	64.85
Other Services	25.38	26.29	27.00	28.69	30.46	32.69
Less: Imputed Bank Service Charge	-23.15	-24.09	-23.88	-26.79	-28.76	-30.64
Total	963.68	995.34	1,012.66	1,111.28	1,178.48	1,214.79
2. Private Households (Domestic Services)						
	8.28	9.52	10.93	12.04	13.91	15.51
3. Producers of Government Services						
Public Administration	40.76	42.74	43.08	44.08	47.47	
Defence	8.00	8.91	9.63	10.63	11.37	
Education	69.34	76.87	82.75	83.99	89.20	
Health	15.25	17.27	17.43	19.43	20.63	
Agricultural Services	10.52	10.30	11.36	13.52	13.68	
Other Services	17.96	19.58	20.46	22.40	24.08	
Total	161.83	175.67	184.71	194.05	206.43	221.09
Total Product Monetary Economy	1,133.79	1,180.53	1,208.29	1,317.37	1,407.82	1,451.57
Total Gross Product at Factor Cost	1,199.32	1,248.11	1,278.10	1,390.26	1,482.94	1,529.26
Gross Domestic Product Per Capita	KE 92.88	93.15	92.30	96.97	99.82	99.24

Source: Central Bureau of Statistics

⁺Provisional

POPULATION CENSUS 1979

Population, Area and Density by Provinces and Districts

Province/District	Population	Land Area Sq. Km.	Density ⁺
	'000	sq. km.	
Nairobi	827,775	684	1,210
Central Province	2,345,833	13,173	178
Coast Province	1,342,794	83,040	16
Eastern Province	2,719,851	155,759	17
North Eastern Province	373,787	126,902	2
Nyanza Province	2,643,956	12,526	211
Rift Valley	3,240,402	163,884	19
Western Province	1,832,663	8,196	223
Total Kenya	15,327,061	564,162	27

Source: Central Bureau of Statistics

⁺ Persons per square kilometre

AGRICULTURE AND LIVESTOCK
Value of Gross Marketed Production, 1976-980

	KE'000				
	1976	1977	1978	1979 ⁺	1980 ⁺⁺⁺
Cereals					
Wheat	12,047	11,877	11,675	14,886	13,244
Maize	21,623	18,843	10,501	9,363	6,609
Barley	2,625	1,955	2,662	3,354	2,999
Rice	2,690	2,816	2,594	2,826	2,794
Other cereals	343	36	45	50	45
Total	39,333	35,527	27,477	30,479	25,691
Temporary Industrial Crops					
Pineapples	1,317	2,135	2,211	2,036	2,130
Castor and other oil seeds	466	360	585	824	810
Pyrethrum	4,089	3,662	4,106	5,156	5,600
Sugar cane	9,618	13,364	17,392	23,302	26,092
Cotton	1,648	2,343	4,287	4,528	5,674
Tobacco	239	602	858	1,381	1,420
Total	17,377	22,466	29,439	37,227	41,726
Other Temporary Crops					
Pulses	2,127	318	284	846	761
Potatoes	3,128	3,031	3,059	3,050	2,898
Other temporary crops	3,371	3,255	3,297	3,300	2,970
Total	8,626	6,604	6,640	7,196	6,629
Permanent Crops					
Coffee	101,333	192,919	118,822	106,426	116,375
Sisal	3,920	4,800	4,278	6,578	9,508
Tea	32,757	92,729	73,914	67,343	63,075
Coconuts and products	489	526	530	510	512
Wattle	422	471	419	351	492
Cashew nuts	1,175	667	1,006	1,050	1,100
Fruit ⁺⁺ and other permanent crops	1,391	1,281	1,230	1,200	1,140
Total	141,487	293,393	200,199	183,458	192,202
Total Crops	206,823	357,991	263,755	258,360	266,248
Livestock and Related Products					
Cattle and calves for slaughter	19,056	23,437	34,941	29,525	32,039
Sheep, goats and lambs for slaughter	1,021	1,131	1,737	2,136	2,168
Pigs for slaughter	994	1,042	1,207	1,087	878
Poultry and eggs	2,142	2,522	1,578	1,850	1,758
Wool	370	321	346	370	520
Hides and skins	1,476	1,815	2,706	2,287	2,482
Dairy products	12,050	18,836	19,587	17,465	13,830
Total	37,109	49,104	62,102	54,720	53,675
Unrecorded Marketed Production	6,115	7,489	7,532	7,160	7,114
Total	250,047	414,584	333,389	320,240	327,037

⁺ Provisional

⁺⁺ Fruit from other than permanent plants is included in "Other Temporary Crops"

⁺⁺⁺ Forecast based on data available for the first two quarters of 1980.

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ESTIMATES AND FORECAST OF
TOTAL VALUE OF PRODUCTION OF SELECTED AGRICULTURAL COMMODITIES

(Current Prices in KE'000)

	1976 Actual Actual	1978 Estimates	1983 Target	AVERAGE ANNUAL RATES OF GROWTH	
				1976-83 Per Cent	1978-83 Per Cent
FOOD CROPS :					
Maize	94,486	117,436	180,493	9.7	9.0
Wheat	11,248	12,664	17,250	6.3	6.4
Rice	2,670	3,408	6,175	12.7	12.6
INDUSTRIAL CROPS :					
Sugar-cane	8,678	11,305	31,450	20.2	22.7
Cotton (seed)	1,669	2,814	5,950	19.9	16.2
Barley	2,644	3,380	9,240	19.6	22.3
Tobacco	237	564	2,035	36.0	29.3
EXPORT CROPS :					
Coffee	98,792	118,750	145,600	5.7	4.2
Tea	32,763	56,550	81,750	14.0	7.7
Sisal	3,856	4,160	5,800	6.0	6.9
Pineapples	1,314	1,395	4,385	18.8	17.8
Pyrethrum	4,347	5,802	15,295	19.7	21.4
Cashew Nuts	1,159	1,920	4,320	20.7	17.6
LIVESTOCK PRODUCTS :					
Milk (Dairy Products)	60,900	85,519	155,800	14.4	12.8
Beef	34,198	50,690	121,770	19.9	19.2
Sheep and Goats	17,050	23,115	51,250	17.3	17.3
Pigs	1,048	1,360	2,860	15.4	16.0
TOTAL OF MAJOR COMMODITIES	377,059	501,372	841,423	12.2	10.9

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IMPORTS Principal Articles 1971-1979

Quantity

Article	Unit	1971	1972	1973	1974	1975	1976	1977	1978	1979
Food										
Milk, dry	Tonnes	2,406	2,537	297	101	2,085	531	440	249	585
Fish and fish preparations	"	1,598	2,711	3,403	4,725	2,725	1,631	847	769	890
Wheat, unmilled	"	13,000	64,821	77,083	13,744	82,917	50	33,035	90,888	21,152
Maize, unmilled	"	29,077	104	82	728	357	32	32	80	18
Rice not in husk	"	10,203	2,150	-23	1,502	4	10,001	24	11	241
Malt	"	2,936	5,318	1,175	2,231	1,908	-	3,120	1,498	88
Fruit and vegetables ⁺	"	36,395	15,992	13,398	4,938	8,131	5,358	1,638	3,477	2,079
Sugar (beet and cane) refined	"	71,747	103,816	77,485	70,703	12,709	45,501	36,308	46,112	12,504
Sugar Confectionary	"	1,801	1,176	74	472	8	23	14	28	65
Chocolate products	"	426	304	177	220	170	13	41	25	10
Tea	"	8,119	5,697	3,844	2,979	3,025	4,148	5,740	7,763	8,597
Animal and Vegetable Oils and Fats										
Animal oils and fats	Tonnes	13,113	8,406	9,540	12,533	20,574	11,497	8,102	16,638	10,858
Vegetable oils and fats	"	23,983	23,413	23,286	20,059	14,678	39,097	45,786	52,398	47,121
Oils and fats, processed and waxes	"	4,110	4,998	5,475	5,095	3,633	4,708	3,795	1,276	669

⁺ Some goods classified under these heads are not included in this table because relevant quantities are not indicated against the value of such imports in the Annual Trade Reports.

LAWS OF KENYA



The Science and Technology Act

CHAPTER 250

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CHAPTER 250**THE SCIENCE AND TECHNOLOGY ACT****ARRANGEMENT OF SECTIONS***Section***PART I—PRELIMINARY**

- 1—Short title.
- 2—Interpretation.

PART II—NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

- 3—Establishment and composition of the Council.
- 4—Functions of the Council.
- 5—Steering Committee.
- 6—Other committees of the Council.
- 7—Annual report.

PART III—ADVISORY RESEARCH COMMITTEES

- 8—Advisory Research Committees.
- 9—Functions of a Research Committee.
- 10—Reports of Research Committees.

PART IV—RESEARCH INSTITUTES

- 11—Interpretation of Part.
- 12—Establishment of Research Institutes.
- 13—Incorporation of Research Institutes.
- 14—Functions of Research Institutes.
- 15—Establishment of Boards of Management.
- 16—Functions of the Boards.
- 17—Discoveries and inventions.
- 18—Financial provisions.
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SCHEDULES.

CHAPTER 250

THE SCIENCE AND TECHNOLOGY ACT

3 of 1977,
L.N. 232/1977,
7 of 1979.*Commencement: 1st July, 1977*

An Act of Parliament to establish machinery for making available to the Government advice upon all matters relating to the scientific and technological activities and research necessary for the proper development of the Republic; and for the co-ordination of research and experimental development; and for matters incidental thereto and connected therewith

PART I—PRELIMINARY

1. This Act may be cited as the Science and Technology Act. Short title.

2. In this Act, except where the context otherwise requires— Interpretation.
7 of 1979, s. 3.

“appointed member” means a member of the Council appointed under paragraph (b) of subsection (2) of section 3;

“Council” means the National Council for Science and Technology established by subsection (1) of section 3;

“Director” means a director of a Research Institute appointed under section 19;

“Minister” means the Minister for the time being responsible for matters relating to economic planning;

“Research Committee” means an Advisory Research Committee established by or under section 8;

“Research Institute” means a Research Institute established by or under section 12;

“scheduled Ministry” means a Ministry listed in Part A of the First Schedule;

“scheduled science” means one of the groups of sciences listed in Part B of the First Schedule.

PART II—NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

3. (1) There is hereby established a body to be known as the National Council for Science and Technology. Establishment
and com-
position of
the Council.

(2) The Council shall consist of—

(a) the Permanent Secretaries of the scheduled Ministries;

(b) twelve members appointed by the Minister each of whom shall be a scientist of eminence in a scheduled science, and in making such appointments the Minister shall ensure that each scheduled science is represented by at least one member suitably qualified therein.

(3) The Second Schedule shall have effect with respect to the Council.

(4) There shall be paid to each appointed member such remuneration and allowances as the Treasury may approve.

(5) All moneys necessary for the remuneration and allowances of appointed members and for the other expenses of the Council and the committees thereof shall be paid out of moneys provided by Parliament for that purpose.

**Functions of
the Council.**

4. The functions of the Council shall be—

- (a) to determine priorities for scientific and technological activities in Kenya in relation to the economic and social policies of the Government and its international commitments;
- (b) to advise the Government on a national science policy, including general planning and the assessment of the requisite financial resources;
- (c) to ensure the application of the results of scientific activities to the development of agriculture, industry and social welfare in Kenya;
- (d) to advise the Government on the scientific and technological requirements for the conservation of the natural and social environment in Kenya;
- (e) to ensure co-operation and co-ordination between the various agencies involved in the machinery for making the national science policy;
- (f) to promote public confidence in scientific expenditure and an atmosphere conducive to scientific activities;
- (g) to consider and advise generally on all scientific activities, including—
 - (i) the application of the results of research;
 - (ii) the transfer of technology into agriculture and industry;
 - (iii) scientific and technical manpower (actual and potential);
 - (iv) scientific research (oriented and non-oriented) and technology;

- (v) science education, not only at the advanced level in respect of the quality and quantity of potential manpower training but also at lower levels in respect of general science education for the public; and
- (vi) scientific documentation, statistics, surveys and general information;
- (h) to advise on suitable organizational arrangements for planning, managing and co-ordinating scientific activities at various levels, including the setting up of new Research Committees, and of research councils, research establishments and technical services;
- (i) to advise the Government on the overall financial requirements for the implementation of the national science policy and on disbursements to the agencies concerned;
- (j) to review generally and advise on the programmes and budgets for the promotion of the research and related scientific activities proposed by Ministers concerned and ensure that they are in harmony with the national science policy;
- (k) to carry out independently or in co-operation with any appropriate person, body of persons, agency or institution such surveys and investigations as the Council may consider necessary for its tasks;
- (l) to sponsor such national and international scientific conferences as it may consider appropriate;
- (m) to maintain relationships with corresponding scientific organizations in other countries; and
- (n) to undertake any other activities likely to assist in the carrying out of its functions.

5. (1) The Council shall appoint a committee, to be known as the Steering Committee, to elaborate the general science plan and to co-ordinate the work of other committees of the Council.

Steering
Committee.

(2) The Steering Committee—

- (a) shall consist of the chairman of the Council, who shall be the chairman of the Committee, and at least six other members of the Council;
- (b) may from time to time co-opt other persons as additional members whether such persons are members of the Council or not.

(3) The secretary to the Council shall be the secretary to the Steering Committee and shall attend all meetings thereof but shall not be entitled to vote.

(4) The quorum of the Steering Committee shall be not less than one-half of its current membership.

Other
committees of
the Council.

6. (1) The Council may from time to time appoint such working or other committees as it may think fit, and may provide for the regulation of the proceedings of any such committee, including the quorum thereof.

(2) A committee appointed under this section—

(a) shall consist of a member of the Council, who shall be the chairman of the committee, and of such other members of the Council (if any) as the Council may think appropriate; and

(b) may co-opt any person as an additional member of the committee, whether such person is a member of the Council or not.

Annual
report.

7. As soon as may be after the end of each year, the Council shall furnish to the Minister a report on the activities of the Council during that year.

PART III—ADVISORY RESEARCH COMMITTEES

Advisory
Research
Committees.

8. (1) There are hereby established the Advisory Research Committees set forth in the first column of Part A of the Third Schedule.

(2) The Minister may, by notice in the Gazette—

(a) add further Research Committees to the Third Schedule, which shall be deemed to have been established under subsection (1) from the date of the publication of the notice or from such later date as the Minister may specify therein;

(b) amend the third column of the Third Schedule.

(3) Part B of the Third Schedule shall have effect with respect to a Research Committee.

(4) All moneys necessary for the payment of salaries and allowances of members of the Research Committees, other than public officers, and of other expenses of such Committees shall be paid out of moneys provided by Parliament for that purpose.

Functions of
a Research
Committee.

9. The functions of a Research Committee shall be—

(a) to advise, within its sector of scientific responsibility, all appropriate Ministers on:

- (i) the details of the research programmes and projects required to implement the research priorities arising from the national science policy;
 - (ii) the concomitant budget requirements so arising;
 - (iii) the encouragement, promotion and co-ordination of all types of research; and
 - (iv) the application of the results of research through the technical and development services of the Government;
- (b) to consider all types of research (fundamental, applied and developmental) pertaining to its sector of scientific responsibility;
 - (c) to survey and register research programmes, and scientific and research facilities and personnel, governmental and otherwise, throughout Kenya;
 - (d) to record research programmes of interest to Kenya being carried on outside Kenya, including those of the research institutes of the Community;
 - (e) to disseminate information on such research programmes both inside and outside Kenya;
 - (f) to assess the value of those research programmes in terms of their significance to the national economy and so advise the Ministers concerned and the Council;
 - (g) to advise the Ministers concerned and the Council on such organizational changes, including the creation of institutes, as are required to implement, or further the efficiency of, the research required by Kenya;
 - (h) to encourage general education in the scheduled sciences and advise on the sponsoring of post-graduate training, and to advise Ministers and the Council on the manpower and educational requirements for research;
 - (i) to maintain a close liaison with foreign and international bodies or organizations with similar interests;
 - (j) to advise on the publishing of the results of research, particularly in relation to the problems of Kenya and the popularising of such results where their general recognition is considered to be of national importance;

(k) to advise on a quinquennial (or other suitable period related to the Development Plan) programme for research and the estimates for the concomitant budget;

(l) to review, annually, the progress in research and to prepare for each Ministry its detailed programme and expenditure for the following year;

(m) to carry out such other activities as will further the advancement of research and its application to development.

Reports of
Research
Committees.

10. Each Research Committee shall, as soon as may be after the end of each year, compile and publish a report—

(a) containing a statement of the activities of the Committee during that year;

(b) reviewing the major achievements of research within its sector of scientific responsibility during that year; and

(c) showing the status of the programme mentioned in paragraph (k) of section 9 as at the end of that year.

7 of 1979, s. 4.

Interpretation
of Part.

PART IV—RESEARCH INSTITUTES

11. In this Part, unless the context otherwise requires—

“participating Minister” means the Minister for the time being responsible for the matters set out in the fourth column of the Fourth Schedule;

“responsible Minister” means the Minister for the time being responsible for the matters set out in the third column of the Fourth Schedule.

Establishment
of Research
Institutes.

12. (1) There are hereby established the Research Institutes set forth in the first column of the Fourth Schedule.

(2) The Minister may on the advice of the Council and after consultation with the appropriate responsible Minister and participating Ministers, by notice in the Gazette, add further Research Institutes to the Fourth and Fifth Schedules and amend any of the provisions therein.

Incorporation
of Research
Institutes.

13. Each Research Institute shall be a body corporate with perpetual succession and a common seal and shall have power to sue and be sued in its corporate name and to acquire, hold and dispose of movable and immovable property for its own purposes.

14. The functions of Research Institutes shall be—

Functions
of Research
Institutes.

- (a) to carry out research in the fields specified in the Fifth Schedule;
- (b) to co-operate with other organizations and institutions of higher learning in training programmes and on matters of relevant research;
- (c) to liaise with other research bodies within and outside Kenya carrying out similar research;
- (d) to disseminate research findings;
- (e) to co-operate with the responsible Ministry, the Council and the relevant Research Committee, in matters pertaining to research policies and priorities;
- (f) to do all such things as appear to be necessary, desirable or expedient to carry out its functions.

15. (1) There shall be a Board of Management for each Research Institute which shall consist of—

Establishment
of Boards of
Management.

- (a) the Permanent Secretary of the responsible Ministry or his representative;
- (b) the secretary of the Council or his representative;
- (c) the secretary of the relevant Research Committee;
- (d) the Director of the Research Institute, who shall be the Secretary to the Board;
- (e) the Permanent Secretaries of the participating Ministries or their representatives;
- (f) not more than seven members, appointed by the responsible Minister, who shall be qualified persons in matters relating to the research activities of the Research Institutes.

(2) The responsible Minister shall appoint a chairman from among the members appointed under this section.

(3) The Sixth Schedule shall have effect with regard to appointments to and procedures of Boards of Management.

(4) The moneys necessary for the payment of salaries and allowances of members of Boards, other than public officers, and of other expenses of such Boards, shall be paid out of moneys provided by Parliament for that purpose.

16. The functions of Boards of Management shall be—

Functions of
the Boards.

- (a) to administer the property and funds of the Research Institute in such manner and for such purposes as will, in the opinion of the Board, promote its best interests;

- (b) on the advice of the relevant Research Committee, to approve and submit through the responsible Ministry programmes of research and financial estimates for the consideration of the Council and the Treasury;
- (c) to administer approved estimates;
- (d) to receive on behalf of the Research Institute grants in aid, gifts, donations, fees, subscriptions or other moneys and make disbursements therefrom;
- (e) to make regulations governing the appointment, conduct and discipline of employees of the Research Institute;
- (f) in consultation with the Council to draw up a scheme of service for employees of the Research Institute;
- (g) to administer the approved terms and conditions of service, including appointments, dismissals, remuneration and retiring benefits, of employees of the Research Institute;
- (h) to manage the secondment of personnel to and out of the Research Institute in co-operation with other agencies;
- (i) to appoint such employees upon terms and conditions to be laid down by the Board after consultation with the Council as it considers necessary for the efficient conduct and operation of the Research Institute.

**Discoveries
and
inventions.**

17. (1) All rights in all discoveries, inventions and improvements in respect of processes, apparatus and machines made on behalf of Research Institutes shall vest in the respective Research Institute but may be made available by it for use in the public interest.

(2) Publication relating to work carried out on behalf of a Research Institute shall be subject to approval by the Institute.

**Financial
provisions.**

18. (1) Each Research Institute shall be financed by grants in aid through the responsible Ministry, but it may also accept gifts, donations, subscriptions, fees and other moneys for the implementation of approved programmes.

(2) The financial year of each Research Institute shall be the same as the Government financial year.

(3) The estimates of each Research Institute shall be submitted through the responsible Ministry for approval by the Treasury on the advice of the Council and shall make

provisions for all the expenditure of the Research Institute for the financial year concerned, and in particular shall provide for--

- (a) the payment of salaries, allowances and all other charges in respect of employees of the Research Institute;
- (b) the payment of pensions, gratuities and all other charges in respect of retirement benefits payable out of the funds of the Research Institute;
- (c) the procurement, proper maintenance, repair and replacement of equipment and other movable property of the Research Institute;
- (d) the proper maintenance of the buildings and grounds of the Research Institute;
- (e) the funding of research activities in the Research Institute;
- (f) the creation of such reserve funds to meet future or contingent liabilities in respect of retiring benefits, insurance or replacement of buildings or equipment, or in respect of such other matters, as the Board may think fit;
- (g) the cost of Board meetings;
- (h) capital expenditure.

(4) The Board of Management shall cause to be kept and the Director shall keep all proper books of account of the Research Institute.

(5) The accounts of each Research Institute shall be audited by the Controller and Auditor-General.

(6) The disposal of fixed assets by the Board of Management shall be subject to the approval of the Treasury.

19. (1) The responsible Minister shall, on the recommendation of the relevant Board of Management, appoint a Director of each Research Institute who shall hold office on such terms and conditions of service as may be specified in the instrument of his appointment.

Director.

(2) The Director, who shall be competent in research matters relating to the Research Institute, shall be its chief executive officer and responsible to the Board of Management for its management.

20. Each Research Institute shall, as soon as possible after the end of each financial year, compile and publish a report containing—

Annual Report.

- (a) a statement outlining its activities and major achievements during the previous year, and its future programmes of research; and
- (b) a statement of accounts for that year.

FIRST SCHEDULE

(s. 2)

PART A—THE SCHEDULED MINISTRIES

The Office of the President and the Ministries under the direction of the Ministers for the time being responsible for matters relating to—

- (a) agriculture;
- (b) commerce and industry;
- (c) social services;
- (d) education;
- (e) finance and economic planning;
- (f) health;
- (g) housing;
- (h) lands;
- (i) natural resources;
- (j) power and communications;
- (k) public works;
- (l) wildlife;
- (m) water development; and
- (n) foreign affairs.

PART B—THE SCHEDULED SCIENCES

- (a) agricultural and allied sciences;
- (b) physical sciences (including chemical sciences and mathematics);
- (c) industrial sciences, engineering and technology;
- (d) medical sciences (including pharmacology);
- (e) natural sciences (biosciences and geosciences); and
- (f) social sciences.

SECOND SCHEDULE

(s. 3 (3))

PROVISIONS AS TO THE NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

1. Save as hereinafter provided, an appointed member shall hold office for such period not exceeding three years as the Minister may specify in the instrument of appointment, and shall be eligible for reappointment.

2. An appointed member may at any time, by notice in writing addressed to the Minister, resign his office, and any such resignation shall have effect from the date of receipt of the notice by the Minister.

3. If the Council so recommends, the Minister may, by notice in writing addressed to an appointed member, terminate the appointment of such member without assigning any reason therefor, and such termination shall have effect from the date of receipt of the notice by the member or from such later date as the Minister may specify in the notice.

4. A Permanent Secretary who is a member of the Council may, with the consent of the Minister, appoint a public officer holding a rank not below Under Secretary to be an alternate member of the Council and such alternate member may exercise any of the functions, as member of the Council, of such Permanent Secretary during any period in which the Permanent Secretary is prevented by any reasonable cause from exercising such functions personally.

5. The Minister shall appoint an appointed member to be chairman of the Council who shall hold office as such for a period of two years, unless he sooner ceases to be a member of the Council, and shall be eligible for reappointment as chairman, so however that no person shall hold office as chairman for more than two such periods consecutively.

6. The Public Service Commission shall appoint a person who is qualified in a scheduled science to be the secretary to the Council, and the secretary shall attend all meetings of the Council but shall not be entitled to vote thereat.

7. Where the Minister is satisfied that, owing to illness, absence or other reasonable cause, the chairman of the Council or any other appointed member is temporarily unable to exercise his functions as such, he may appoint another appointed member to act as chairman, or a suitably qualified person to act as appointed member, as the case may be, during the period of such disability.

8. Save as hereinafter provided the Council may regulate its procedure as it thinks fit.

9. The Council shall meet not less than twice in each year.

10. The quorum of the Council shall be six *ex officio* members and six appointed members.

11. The chairman of a research committee, and any other person permitted to do so by the Council, may attend any meeting of the Council and participate in its proceedings, but shall not be entitled to any vote at such meeting.

THIRD SCHEDULE (s. 8)**PART A—RESEARCH COMMITTEES**

1	2	3
<i>Committee</i>	<i>Minister responsible</i>	<i>Participating Ministers</i>
The Agricultural Sciences Advisory Research Committee.	Agriculture	(i) Natural Resources. (ii) Wildlife. (iii) Water Development.
The Medical Sciences Advisory Research Committee.	Health	—
The Industrial Sciences Advisory Research Committee	Industry	(i) Social Services. (ii) Housing. (iii) Power and Communications. (iv) Public Works.
The Natural Sciences Advisory Research Committee.	Natural Resources	(i) Lands. (ii) Wildlife. (iii) Water Development.

PART B—PROVISIONS AS TO RESEARCH COMMITTEES**1. In this Schedule—**

"the Minister responsible", in relation to a Research Committee, means the Minister for the time being responsible for matters relating to the subject set forth in column 2 of Part A in respect of that Committee;

"participating Minister", in relation to a Research Committee, means a Minister who is for the time being responsible for matters relating to one of the subjects set forth in column 3 of Part A in respect of that Committee.

2. A Research Committee shall consist of the following members appointed by the Minister responsible after consultation with the participating Ministers—

- (a) a chairman who shall be a person of distinction in the sector of scientific responsibility of the Committee;
- (b) not more than ten members who are research scientists or technologists representing that sector of scientific responsibility; and
- (c) not more than three members who have close association with the development and use of the scheduled sciences included in that sector of scientific responsibility.

3. Save as hereinafter provided—

- (a) the chairman of a Research Committee shall hold office for a period of five years and shall be eligible for reappointment, so however that no person shall hold such office for more than two such periods consecutively;
- (b) a member, other than the chairman, of a Research Committee, shall hold office for a period of three years up to a maximum consecutive period of seven years.

4. A member of a Research Committee may at any time, by notice in writing addressed to the Minister responsible, resign his office, and any such resignation shall have effect from the date of receipt of the notice by the Minister.

5. If a Research Committee so recommends, the Minister responsible may, after consultation with the participating Ministers and by notice in writing addressed to a member of that Committee, terminate the appointment of such member without assigning any reason therefor, and such termination shall have effect from the date of receipt of the notice by the member or from such later date as the Minister responsible may specify.

6. Where the Minister responsible for a Research Committee is satisfied that, owing to illness, absence or other reasonable cause, the chairman or any other member of the Committee is temporarily unable to exercise his functions as such, he may appoint a suitably qualified person to act as chairman or as a member, as the case may be, during the period of such disability and may at any time revoke such temporary appointment.

7. Save as hereinafter provided, a Research Committee may regulate its procedure as it thinks fit.

8. The quorum of a Research Committee shall be not less than one-half of its current membership.

9. Where the chairman of a Research Committee is unable for any reason to attend a meeting thereof, the members present may elect one of their number to preside at that meeting.

10. The following persons shall be entitled to attend a meeting of a Research Committee and to take part in the deliberations thereat, but not to vote—

- (a) representatives of the Minister responsible or of a participating Minister;
- (b) a Director or other head of a Government Research Department;
- (c) a member of the Council or of its secretariat;
- (d) representatives of any other Minister who has sought the advice of the Committee on any matter which is being considered at that meeting.

11. After consultation with a Research Committee the Minister responsible shall appoint a public officer to be the secretary to the Committee who shall manage the affairs of the Committee under its direction.

12. (1) A Research Committee may appoint such standing and other sub-committees as it may consider necessary for the more efficient performance of its functions.

(2) A sub-committee appointed under this section shall consist of a chairman who shall be one of the members of the Research Committee and such other persons, whether or not members of the Committee, as the Committee may think fit.

(3) A Research Committee may at any time dissolve, or vary the composition of, any sub-committee appointed by it.

(4) A Research Committee may fix the quorum of a sub-committee appointed by it, and may regulate the proceedings thereof in such manner as the Committee may think fit.

13. Any member of a Research Committee or of a sub-committee thereof who has a personal interest in any contract or arrangement proposed to be considered at a meeting of the Committee or sub-committee shall forthwith declare his interest to the meeting and shall not vote on any question relating to such contract or arrangement.

FOURTH SCHEDULE

(s. 12 (1))

RESEARCH INSTITUTES

<i>Research Institute</i>	<i>Relevant Advisory Research Committee</i>	<i>Responsible Ministry</i> (Ministry responsible for matters relating to)	<i>Participating Ministry</i> (Ministry responsible for matters relating to)
Kenya Agricultural Research Institute.	Agricultural Sciences Advisory Research Committee.	Agriculture	(i) Natural Resources. (ii) Health. (iii) Water Development. (iv) Commerce and Industry (v) Wildlife. (vi) Lands. (vii) Power and Communications.
Kenya Industrial Research and Development Institute.	Industrial Sciences Advisory Research Committee.	Industry	(i) Agriculture. (ii) Health. (iii) Housing. (iv) Labour. (v) Works. (vi) Power and Communications. (vii) Water Development. (viii) Natural Resources.
Kenya Marine and Fisheries Research Institute.	Natural Sciences Advisory Research Committee.	Fisheries	(i) Natural Resources. (ii) Water Development. (iii) Health. (iv) Power and Communications.
Kenya Medical Research Institute.	Medical Sciences Advisory Research Committee.	Health	(i) Agriculture. (ii) Social Services. (iii) Water Development. (iv) Commerce and Industry. (v) Education. (vi) Natural Resources.
Kenya Trypanosomiasis Research Institute.	Medical Sciences Advisory Research Committee.	Health	(i) Wildlife. (ii) Agriculture.

FIFTH SCHEDULE

(s. 14 (a))

DETAILS OF FIELDS OF RESEARCH TO BE UNDERTAKEN

<i>Research Institute</i>	<i>Field of Research</i>
Kenya Agricultural Research Institute.	Agriculture. Veterinary Sciences. Forestry.
Kenya Industrial Research and Development Institute.	Industrial and allied Technology including— Civil Engineering, Mechanical Engineering, Textile Technology, Electrical Engineering, Mining, Power Resources, Chemical Engineering, Industrial Chemistry, Food Technology, Ceramics and Clay Technology.
Kenya Marine and Fisheries Research Institute.	Marine and Freshwater Fisheries. Aquatic Biology including— Environmental and Ecological Studies. Marine Research including— Chemical and Physical Oceanography.
Kenya Medical Research Institute.	Biomedical Sciences.
Kenya Trypanosomiasis Research Institute.	Human and Animal Trypanosomiasis.

SIXTH SCHEDULE

(s. 15 (3))

PROVISIONS AS TO BOARDS OF MANAGEMENT OF RESEARCH INSTITUTES

1. Subject as hereinafter provided—

- (a) an appointed member shall hold office for three years but shall be eligible for reappointment;
- (b) the chairman shall hold office for three years or such shorter term as remains for his membership of the Board but shall be eligible for reappointment as chairman.

2. The chairman and any appointed member may at any time, by notice in writing addressed to the responsible Minister, resign his office, and any such resignation shall have effect from such date as the responsible Minister may decide.

3. The responsible Minister may terminate the appointment of the chairman or any member of the Board appointed by him without assigning any reason therefor, and such termination shall have effect from the date of receipt of the notice by the member or from such later date as the Minister may specify in the notice.

4. Where the responsible Minister is satisfied that owing to illness, absence or other reasonable cause the chairman or any other appointed member is temporarily unable to exercise his functions as such, he may appoint another appointed member as chairman, or a suitably qualified person to act as appointed member, as the case may be, during the period of such disability.

5. A quorum of any Board shall be one third of the current membership.

6. Decisions of any Board shall be by majority vote of the members present if a quorum, but in the event of a tie the chairman shall have a casting vote.

7. Each Board shall meet not less than three times in any calendar year.

8. Subject to the foregoing Boards may regulate their own procedures.

9. The common seal of each Board shall be authenticated by the signatures of two members of the Board authorized in that behalf.

10. Any document purporting to be a document duly executed or issued under the seal of a Board or on behalf of a Board shall be received in evidence and be deemed to be a document so executed or issued without further proof unless the contrary is shown.



PRODUCTION OF DIPLOMATES - EGERTON COLLEGE, NJORO

1968 - 1978

DIPLOMA STREAM	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	TOTAL
Agriculture and Home Economics	-	-	-	20	27	23		29	20	23	13	155
Animal Husbandry	18	35	37	28	32	32		36	34	40	40	332
Agriculture	17	39	47	18	19			15	9	19	28	227
Horticulture	-	-	-	-	10	12		10	12	11	12	67
Dairy Technology	7	15	34 ⁺	No - graduates	12	16	NO GRADUATION	18	11	11	7	131
Farm Management	-	23	17	18	13	15		18	18	30	31	183
Agricultural Education	-	7	37	46	41	42		40	28	33	33	307
Agricultural Engineering	14	23	23	23	17	11		20	24	30	24	209
Range Management	14	18	16	16	18	25		21	20	29	27	204
Forestry	13 [*]											
	83	160	211	169	189	192		207	176	226	215	1,828

* The last Forestry students

+ Dairy students graduated twice, 1968 class (14 students) graduated in February and 1969 class (20 students) graduated in December

Allocation and Utilization of Resources in Agricultural Research

Station (A) National Stations	Main Programme	Land	Technical Staff	Lab. & Office Facilities	Financial Resources allocated 1980/81
1. National Agricultural Res. Station, Kitale	Maize and Pasture breeding and agronomy. Animal Production	912 ha main station No substations	26 R.O. (Kenyan) 2 R.O. (Expatriate) 50 Technicians	Adequate	Recurrent #99,670* Development #6425
2. National Sugar Research Station, Kibos	Sugarcane selection and agronomy	212 ha main station 14 ha sub-station, south Mwanza	9 R.O. (Kenyan) inc. 1 MSc, 1 PhD. 24 Technicians	Adequate	Recurrent #21,305* Development #243,000
3. National Plant Breeding Station, Njoro	Wheat, Barley, oil crops breeding and agronomy	400 ha main station No substations	21 R.O. (Kenyan) 3 R.O. (Expatriate) 8 Technologists	Inadequate	
4. National Agricultural Laboratories, Kabere	Soil, Chemistry, Soil Survey, Irrigation and Drainage, Pesticide anal.	20 ha Kabete No substations	57 R.O. (Kenyan) 3 R.O. (Expatriate) 36 Technical Officers 70 Technical Assistants	Inadequate	Recurrent #52,872* 1979/80 Development #93,226 1979/80
5. National Horticulture Research Station, Thika	Selection and agronomy of horticultural crops - fruits, vegetables and dry beans. Sericulture	365 ha main station 24 ha substation - Gituamba	36 R.O. (Kenyan) 5 R.O. (Expatriate) 44 Technical Officers	Inadequate	Recurrent #50,835 Development #85,265 Technical Assistance Personnel #355,600 Operating Costs #503,750
6. National Dryland Research Station, Katwani	Farming Systems for dryland agriculture. Integrated crop/livestock programme		14 R.O. (Kenyan) 12 R.O. (Expatriate)	Grossly Inadequate	
7. National Potato Research Station, Tigoni	Potato selection, breeding and agronomy	97 ha main station 2.4 ha Njabini 3.2 ha Marimba	11 R.O. (Kenyan) 8 Technical Officers 16 Technicians	Inadequate	Recurrent #54,830* Development #23,180

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Station	Main Programme	Land	Technical Staff	Lab. & Office Facilities	Financial Resources Allocation 1980/81
8. Coffee Research Foundation	Coffee breeding, agronomy and plant protection. Extension liaison.	255 ha main station 126 ha Koru 10 ha Kisii 23 ha Meru 63 ha Azania (Kiambu)	18 R.O. (Kenyan) 3 F.O. (Expatriate) 12 Technical Officers 3 Technicians.	Adequate	Recurrent £620,500 Development £87,317
9. Tea Research Foundation	Clonal selection and agronomy of Tea.	390 ha Kericho No sub-stations	4 R.O. 23 Technicians	Adequate	£ 138,018 Recurrent No Development
10. National Animal Husbandry Research Station, Naivasha	Breeding and nutrition of livestock - mainly cattle, sheep and goats and poultry.	2560 ha main station 1457 ha Olmagogo	8 R.O. (Kenyan) 11 Technical Officers 19 Technical Assistants	Inadequate	Recurrent £160,802* 1979/80 Development £27,400 1979/80
11. National Range Research Station, Kiboko	Improvement of animal production under rangeland	30,000 ha main station 2,000 ha Buchuma 23 ha Chemerone	10 R.O. (Kenyan) 6 R.O. (Expatriate) 11 Technical Officers	Adequate	Recurrent £31,080* Development £36,700
12. Veterinary Research Laboratories, Kabete	Diagnostic service and research into cattle, sheep, goat and poultry diseases.			Adequate	Recurrent £669,791 Development £286,015
13. Agricultural Research Department, Muguga.	Dryland Cropping Systems research, biological control, virology and animal production.	1174 ha main station 1619 ha Athi River	39 R.O. (Kenyan) 10 R.O. (Expatriate) 16 Technologists 74 Technicians	Adequate	Recurrent £1,311,389 1979/80 Development £362,160 1979/80
14. Veterinary Research Department, Muguga	Veterinary Research		20 R.O. (Kenyan) 8 R.O. (Expatriate) 10 Lab. Technologists	Adequate	Recurrent £659,753 Development £152,888

Stations B) Regional Stations	Main Programme	Land	Technical Staff	Lab. & Office Facilities	Financial Resources allocated 1980/81
1. Western Agricultural Research Station, Kakamega	Sorghum & Millet breeding and agronomy, horticulture, maize agronomy, groundnuts, animal production.	101 ha main station 223 Alupe	6 R.O.	Inadequate	
2. Nyanza Agricultural Research Station, Kisii	Maize agronomy, sorghum & millet grain legume and horticulture	100 ha main station 4 ha Homa Bay 4 ha Oyani 7 ha Kilgoria	5 R.O. (Kenyan) 5 Technical Officers 19 Technicians	Inadequate	Recurrent £23,895* 1979/80 Development ?
3. Pyrethrum & Horticultural Research Station, Molo	Pyrethrum and horticulture research	225 ha main station 266 Marindas 50 ha Perkera 6 ha Limuru.	8 R.O. (Kenyan) 10 Technical Officers 20 Technicians	Inadequate	Recurrent £116,812 1979/80 Development £118,297
4. Nyandarua Agricultural Research Station, Ol Joro Crok	Animal production especially pigs, sheep and goats. Maize breeding.	405 ha main station No substations	2 R.O. (Kenyan) 4 Technical Officers 6 Technical Assistants	Inadequate	Recurrent £47,573 Development - NIL
5. Embu Agricultural Research Station, Embu	Maize agronomy, pasture and fodder crops.	71 ha main station 19 ha Murinduko	4 R.O. (Kenyan) 3 Technical Officers 13 Technical Assistants	Inadequate	Recurrent £83,230 Development £4,825
6. Mwea-Tebere Agricultural Research Station, Mwea-Tebere	Cotton and sunflower selection and agronomy.	50 ha main station 32.5 ha Giaki	8 R.O. (Kenyan) 2 R.O. (Expatriate) 14 Technical Assistants	Moderate	Recurrent £26,900 Development £34,000
7. Coast Agricultural Research Station, Mtwapa	Coconut, cashew, cassava, citrus, maize, vegetables and cowpeas	242 ha main station 20 ha Matuga 16 ha Msabaha 8 ha Mpeketoni	15 R.O. (Kenyan) 1 R.O. (Expatriate) 4 Technical Officers 16 Technical Assistants	Very Inadequate	Recurrent £79,718

N.B. * indicates that the figure does not include Personal Emoluments.

<u>Stations</u> B) Regional Stations	Main Programme	Land	Technical Staff	Lab. & Office Facilities	Financial Resources allocated 1980/81
8. Animal Husbandry Research Station, Mariakani	Livestock production - sheep and goats, cattle	400 ha	2 R.O. (Kenyan)	Inadequate	
9. Cotton Research Station, Kibos	Cotton selection and agronomy	20 ha main station	4 R.O. (Kenyan) 16 Technical Assistants	Adequate	
10. Beef Research Station, Lanet	Beef Research	1632 ha main station No substation	3 R.O. (Kenyan) 4 Technical Officer 1 Technician	Inadequate	Recurrent #312,220 1979/80 Development #521,473 1979/80
11. Ahero Irrigation Research Station, Kisumu	Water Management, pest control, rice agronomy.	Undefined - Ahero Irrigation Scheme Substation - Mwea Tehera	4 R.O. (Kenyan) 1 R.O. (Expatriate)	Inadequate	

List of Donor-Assisted Research and Research-Related Projects

Ministry of Agriculture (MINAG)

1. ICIF& Capital Development	OPEC
2. Development and General Planning Minag	USAID/UNDP/FRG
3. Yala Swamp Development (Irrigation and Soil and Water Conservation)	Netherlands
4. Sugar Rehabilitation & Research Projects	IBRDD
5. Plant Breeding Research, Njoro	CIDA
6. Dryland Farming Research Project	FAO/UNDP
7. Irrigation Research Project	Netherlands
8. Crops Post-Harvest Improvement Project	USAID
9. Grain Storage Research & Handling Project	DANIDA/UK
10. West Kano Pilot Irrigation Scheme	EEC
11. Mwea Irrigation Project	Kuwait
12. Soil Conservation Research & Services	U.K.
13. Turkana Region Irrigation Cluster	NORAD
14. Ewaso Nyiro Irrigation Cluster	ODA
15. Mitungnu Irrigation Scheme	KFW
16. Muka Mukum Settlement & Irrigation Scheme	KFW
17. Integrated Agricultural Development Program Phase I	IBRD/IDA/BADEA
18. Group Farm Rehabilitation Project	IBRD/IDA
19. Smallholder Coffee Improvement Project	IBRD/IDA
20. Narok Agricultural Development Project	IDA
21. Machakos Integrated Development Project	EEC
22. Soil Conservation Project	SIDA
23. Baringo ASAL Project	IDA/IBRD
24. Kitui ASAL Project Planning Unit	USAID
25. Kitui SAL - Soil Conservation	USAID
26. Water Conservation - Embu, Meru, Isiolo	ODA
27. IADP II - Soil/Water Conservation	IDA/IFAD
28. IADP II - Small Scale Irrigation	IDA/IFAD
29. IADP II - Coconut Development	IDA/IFAD
30. IADP II - Research Development	IDA/IFAD
31. Agricultural Information and Documentation	U.K.
32. Nduruba Institute of Agriculture	IBRD/IDA
33. Embu Institute of Agriculture	IBRD/IDA
34. Egerton College	USAID
35. Bukura Institute	IBRD/IDA

Ministry of Livestock Development (MLD)

1. Capital Development	DANIDA
2. Runderpest Program	SIDA/IDA
3. Foot and Mouth Disease Control	SIDA
4. National Tick Control Program	EEC
5. Wildlife Disease Control	CIDA
6. Kiboko Range Research	USAID
7. Small Ruminants Research Support Program	USAID
8. Bee-keeping Project	CIDA
9. Poultry Development Project	Netherlands
10. Rural Milk Project	Finland
11. Range Development and Improvement	IDA
12. Integrated Agricultural Development Program - Phase I	IBRD/IDA/BADEA
13. IADP Phase II Annual Production	IDA/IFAD
14. Machakos Integrated Development Project	EEC
15. IADP Kericho District Tick Control	DANIDA
16. IADP Baringo Semi-Arid Area Project	IDA
17. IADP Narok Agricultural Development Project	IDA
18. Naivasha Dairy Training School	DANIDA

Estimated Research Expenditure in relation to production values of
agricultural commodities - 1979/80

Commodity	A	B	C	D	% Value	% Expenditure
	Estimated ^{**} Production Value K£,000	Research ^{**} Expenditure K£ Local	Research Expenditure External aid K£	Total Research Expenditure K£	Col. A	Col. D
Coffee	106,426	677,654	50,000	727,654	33.2	26.7
Tea	67,343	138,018	-	138,018	21.0	5.1
Maize	9,363	218,889	10,944	229,833	2.9	8.4
Wheat	14,886	39,205	-	39,205	4.6	1.4
Sugar	23,302	101,131	-	101,131	7.3	3.7
Other food crops	20,356	267,850	160,688	428,538	6.4	15.7
Oil & fibre crops	12,440	206,916	18,444	225,360	3.9	8.3
Horticulture	4,286	175,951	37,290	213,241	1.3	7.8
Livestock: Beef & Milk	61,890	405,191	94,350	499,541	19.3	22.8
Range Research		88,170	34,945	123,115		
T o t a l	320,292	2,318,975	406,661	2,725,636		

Note

Col. A : Recorded marketed production in 1979 published by Central Bureau of Statistics.
Col. B, C and D : Based on survey of estimated expenditure on research projects, excluding general overheats.

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Planned Development and Recurrent Expenditure - Ministry of Agriculture

							in KE,000)	
		1978/79	1979/80	1980/81	1981/82	1982/83	Total Fourth Plan	Percentage
General Administration and Planning	Recurrent Development	2,342 573	2,400 1,237	2,472 974	2,546 910	2,622 1,017	12,382 4,711	4.4
	TOTAL	2,915	3,637	3,446	3,456	3,639	17,093	
Livestock Development	Recurrent Development	8,201 7,215	9,239 6,784	10,608 6,854	12,285 6,981	14,102 7,688	54,435 35,522	23.0
	TOTAL	15,416	16,023	17,462	19,266	21,790	89,957	
Crop Development	Recurrent Development	5,331 14,738	7,259 27,051	8,235 30,280	8,568 32,136	9,014 42,149	38,407 146,354	47.2
	TOTAL	20,069	34,310	38,515	40,704	51,163	184,761	
Land and Farm* Development	Recurrent Development	1,188 2,944	1,816 3,717	1,950 4,173	2,106 4,507	2,295 5,508	9,355 20,849	7.7
	TOTAL	4,132	5,533	6,123	6,613	7,803	30,204	
Agricultural Education	Recurrent Development	3,958 1,329	1,822 1,992	2,030 3,384	2,191 3,964	2,366 4,439	12,367 15,108	7.0
	TOTAL	5,287	3,814	5,414	6,155	6,805	27,475	
Agricultural Finance Corporation	TOTAL	3,620	4,495	5,365	5,484	7,976	26,940	6.9
Agricultural Development Corporation	TOTAL	1,750	1,300	510	510	520	4,590	1.1
Joint Research Services	Recurrent Development	1,360 366	1,464 424	1,611 460	1,772 508	1,949 703	8,156 2,461	2.7
	TOTAL	1,726	1,888	2,071	2,280	2,652	10,617	
Ministry of Agriculture	Recurrent Development	22,380 32,535	24,000 47,000	26,906 52,000	29,468 55,000	32,348 70,000	135,002 256,535	100.0
	TOTAL	54,915	71,000	78,906	84,468	102,348	391,637	

* Includes subvote for Area Development.

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Planned and Actual Expenditure for Agricultural Research (KE '000) at Current Prices

	1977/78	1978/79	1979/80		1980/81		1981/82	1982/83	Five Year
	Actual	Actual	Provision	Actual	Provision	Actual	Provision	Provision	Plan Total Provision
<u>Veterinary Research</u>									
Recurrent	281	428	477	(508)	529	(587)	627	706	2767
Development	461	164	99	(295)	87	(316)	20	20	410
Total	742	612	576	(803)	616	(903)	647	726	3177
<u>Range Research</u>									
Recurrent	131	234	241	(207)	262	(220)	317	357	1411
Development	37	170	155	(279)	110	(295)	115	120	670
Total	168	404	396	(486)	372	(515)	432	477	2021
<u>Animal Husbandry Research</u>									
Recurrent	242	302	353	(500)	372	(520)	427	471	1925
Development	182	432	361	(191)	461	(211)	305	302	1861
Total	424	734	714	(691)	833	(731)	732	773	3786
<u>Crop Research</u>									
Recurrent	1351	1755	1983	(1763)	2451	(1992)	2767	3120	12076
Development	439	797	1051	(612)	1066	(1459)	1028	1070	5012
Total	1790	2552	3034	(2375)	3517	(3451)	3795	4190	17088
<u>Soil, Plant and Seed Inspection</u>									
Recurrent	80	115	129	(186)	160	(192)	185	210	799
Development	157	182	101	(185)	76	(272)	100	100	599
Total	237	297	230	(371)	236	(464)	825	310	1358
<u>Economic Research and Study</u>									
Finance (Development)	-	280(?)	660	(?)	780	(?)	800	700	3220
<u>Joint Research Services (Muguga)</u>									
Recurrent	1143	1216	1338	(1663)	1471	(1588)	1618	1780	7423
Development	399	367	433	(341)	475	(335)	524	574	2373
Total	1542	1583	1771	(2004)	1946	(1923)	2142	2354	9796
<u>Grand Total</u>									
Recurrent	3228	4050	4521	(4827)	5245	(5099)	5941	6644	26401
Development	1675	2412	2860	(1903)	3055	(2888)	2892	2886	14105
Total	4903	6462	7381	(6730)	8300	(7987)	8833	9470	40446

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Government of Kenya Budgetary Support for Crops and Livestock Research 1980/81 and 1981/82^{x)}

in KE.

	1980/81			1981/82		
	Recurrent	Development	Total	Recurrent	Development	Total
Crops	3,417,166	1,230,743	4,647,909	4,059,751	1,965,096	6,024,847
Livestock	1,600,954	620,050	2,221,004	1,866,393	1,059,252	2,925,645
Totals	5,018,120	1,850,793	6,868,913	5,926,144	3,024,348	8,950,482

x) Excludes Research on Coffee, Tea and National Irrigation.

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Distribution of Research Manpower in Kenya over 12 year period, 1966-1978

		Kenyan				Non Kenyan				Total			
		BSc	MSc	PhD	Total	BSc	MSc	PhD	Total	BSc	MSc	PhD	Total
Coffee	1966	0	2	0	2	6	2	2	10	6	4	2	12
	1969	1	2	1	4	3	6	3	12	4	8	4	16
	1972	2	3	2	7	1	2	5	8	3	5	7	15
	1975	3	4	2	9	0	3	3	6	3	7	5	15
	1978	7	6	2	15	0	0	3	3	7	6	5	18
Tea	1966	0	0	0	0	2	1	0	3	2	1	0	3
	1969	2	0	0	2	3	1	0	4	5	1	0	6
	1972	0	2	0	2	3	1	0	4	3	4	0	7
	1975	0	3	0	3	2	1	0	3	2	4	0	6
	1980	1	2	1	4	0	0	0	0	1	2	1	4
Other Crops & Livestock Ecozone 2	1966	8	6	1	15	28	33	29	90	36	39	30	105
	1969	10	11	1	22	23	38	46	107	33	49	47	129
	1972	85	40	3	128	25	25	33	83	110	65	36	211
	1975	52	46	12	110	23	24	50	97	75	70	62	207
	1978	108	41	13	162	11	17	24	52	119	58	37	214
Other Crops & Livestock Ecozone 3	1966												
	1969												
	1972	0	0	0	0	3	3	1	7	3	3	1	7
	1975	3	2	0	5	1	2	0	3	4	4	0	8
	1978	3	3	0	6	0	1	0	1	3	4	0	7
1980	9	3	0	12	2	0	0	2	11	3	0	14	
Other Crops & Livestock Ecozone 4	1966												
	1969	2	1	0	3	3	2	2	7	5	3	2	10
	1972	3	2	0	5	2	1	3	6	5	3	3	11
	1975	4	3	0	7	0	1	0	1	4	4	0	8
	1978	2	2	0	4	0	0	0	0	2	2	0	4
1980													

Kenya Manpower Training Needs (1981-1990)¹

Public Sector

(i)	Rural afforestation in 40 districts out of the existing 57 including forest management needs = 40x3=	120
(ii)	Research staff to man the 5 stations of Muguga, Turbo, Mombasa, Hola and Kibwezi 15x3 = 45 (30 MSc. + 15 PhD)	45
(iii)	Training - appointees for the Department of Forestry (MSc. level).....	13
	- Teachers for the Londiani Forest Training School (MSc. level).....	10
(iv)	Regional programmes - 10 programmes are already working, some of which are listed below:	
	Tana River Development Authority	
	Lake Victoria Basin Development Authority	
	Kerio Valley Development Authority	
	Baringo Valley Development Authority etc.	
	10x2 = 20	<u>20</u>
	- Total Public Sector	208

Private Sector

(i)	Factories and timber industry	15
(ii)	Small-scale mills and prefabricated housing	15
(iii)	Undetermined yet	<u>30</u>
	Total private sector	60
	Total public and private sector	268

Additional Needs

(i)	Wastage 5% = retirement and resignation 5%	26
(ii)	Foreign students 10%	<u>26</u>
	GRAND TOTAL	320

¹ Samuel Burley 1981. See also Roche 1980

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Forestry Research Needs for Developing Countries(i) Forestry in relation to agriculture and rural development(A) Sociological and institutional research

1. Determination of perceived role of trees and forests in rural welfare
2. Origin and solution of conflicts for land
3. Determination of accountability and response to innovative systems
4. Definition and testing of incentives to incorporate trees
5. Guidelines for project preparation
6. Extension methods
7. Institutional aspects
8. Economic returns from alternative farming systems incorporating trees

(B) Farming systems using trees

1. Ground preparation (especially arid and degraded)
2. Effects and systems of intercropping, including vials
3. Mycorrhizal and other microbiological relations
4. Mulching effects on soil chemistry and structure
5. Impact on soil fertility of burning manure and crop residues
6. Soil nutrients (especially nitrogen and phosphorus, salinity)
7. Moisture relations
8. Irrigation
9. Sand dune stabilization
10. Shelterbelts
11. Choice of species and provenance
12. Seed collection, storage, testing, zonation, certification
13. Silvicultural treatment (coppicing, pollarding)
14. Vegetative propagation
15. Potential of tree breeding

(C) Watersheds (catchments) and range management

1. Farming systems appropriate for upland areas
2. Alternatives for fodder production on and off farms
3. Improvement of alpine pasture lands
4. Impact of land use on water yield, quality and timing
5. Impact on stream flow patterns of shifting cultivation
6. Cost and effectiveness of watershed management
7. Determination of run-off rates and sediment yield
8. Carrying capacity and grazing control to maximize range production
9. Least cost approaches to range improvement
10. Improvement of savannah range lands
11. Improvement of arid zone range lands

(D) Wildlife in relation to rural welfare

1. Ecological monitoring of animal habitats
2. Population behaviour of animals
3. Socioeconomic aspects of the place of animal products in rural life

(ii) Forestry in relation to energy production and use(A) Silviculture of biomass/fuelwood species and systems

1. Choice of species and provenance
2. Tree breeding
3. Seed research
4. Vegetative propagation, tissue culture, cell genetics
5. Ground preparation methods
6. Silvicultural methods
7. Pests and diseases
8. Fire control systems
9. Effect of repeated cropping on soil

(B) Yield, harvesting and properties

1. Yield assessment
2. Harvesting and transport methods
3. Density and calorific value
4. Chemical content

(C) Industrial research related to village technology

1. Improved stove and crematorium design
2. Improved fuelwood and charcoal preparation methods
3. Small-scale crop processors, generators, wood preservation
4. Use of residues

(D) Comparison with alternative fuels (social, technical and economic efficiency)**(E) Wood-based derivatives**

1. Pyrolysis
2. Gasification
3. Pelletization
4. Methanol
5. Ethanol and liquid fuel technology

(iii) Management and conservation of existing resources (mainly natural forests)**(A) Resource survey**

1. Land use planning methods
2. Soil and land use survey and evaluation
3. Monitoring changes of forest area
4. Inventories of accessible natural forest

(B) Conservation

1. Methods to identify and quantify unique biotic associations
2. Methods to conserve genetic resources and ecosystems
3. Monitoring changes within ecosystems and species
4. Policy and legal aspects of conservation
5. Underlying ecological and biological processes

(C) Silvicultural systems for natural forests

1. Natural regeneration
2. Artificial enrichment

(D) Whole tree use

1. Harvesting
2. Utilization
3. Effects on site

(E) Use and marketing of secondary species

1. Inventory
2. Properties
3. Information and market intelligence

(F) Wood preservation**(iv) Industrial forestry****(A) Silviculture and management**

1. Choice of species and provenance
2. Seed collection, storage, testing, zonation, certification
3. Vegetative propagation, tissue culture, cell genetics
4. Tree breeding
5. Ground preparation
6. Spacing, weeding, thinning, pruning
7. Fertilization and soil nutrients
8. Mycorrhizal and microbial relations
9. Integrated pest management
10. Fire control systems

(B) Wood properties

1. Anatomical
2. Chemical
3. Physical/mechanical
4. Pulp, paper, boards
5. Composites

F I G U R E S

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Fig.1. Proposed relationships in Kenya's Agricultural Research System

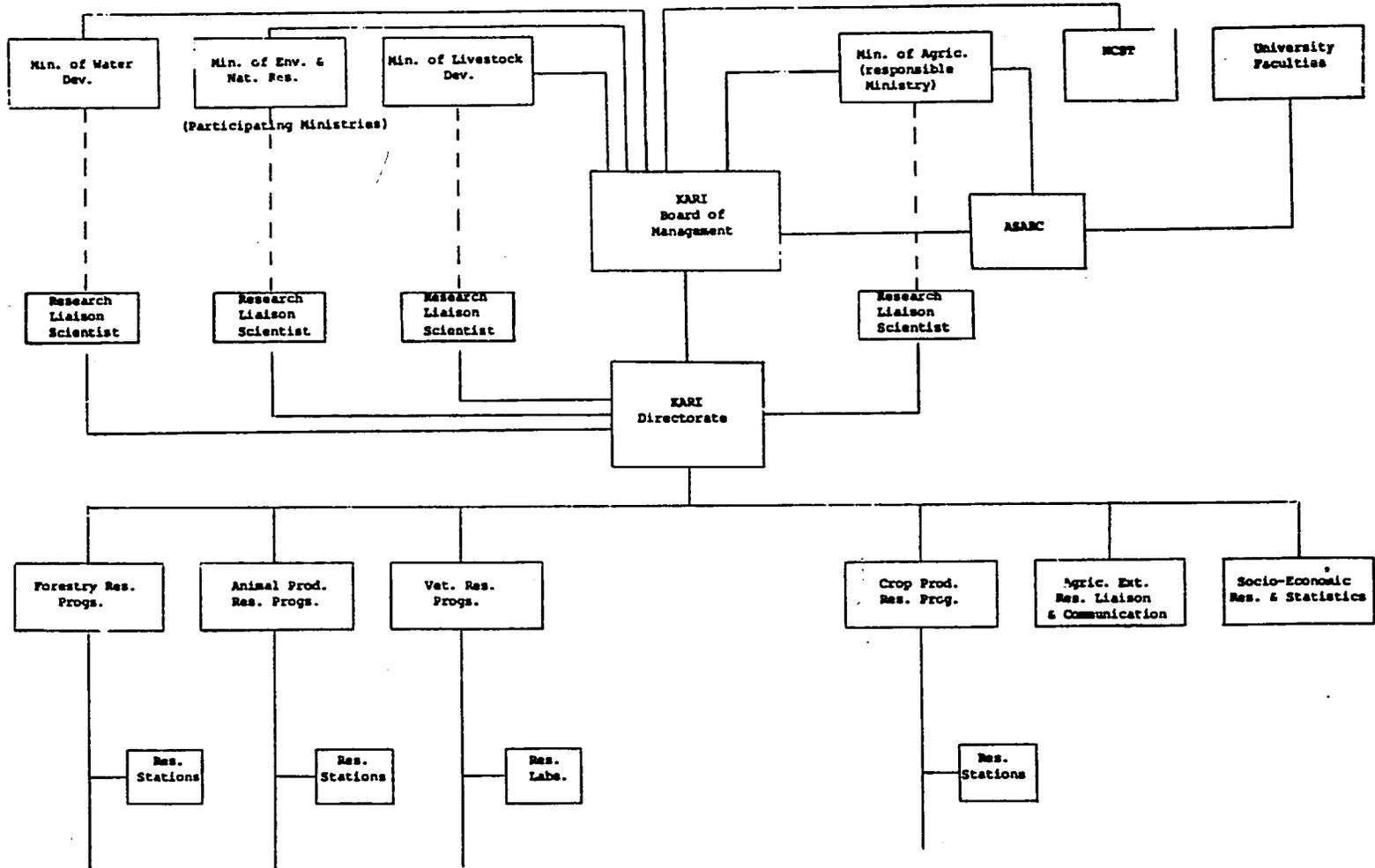
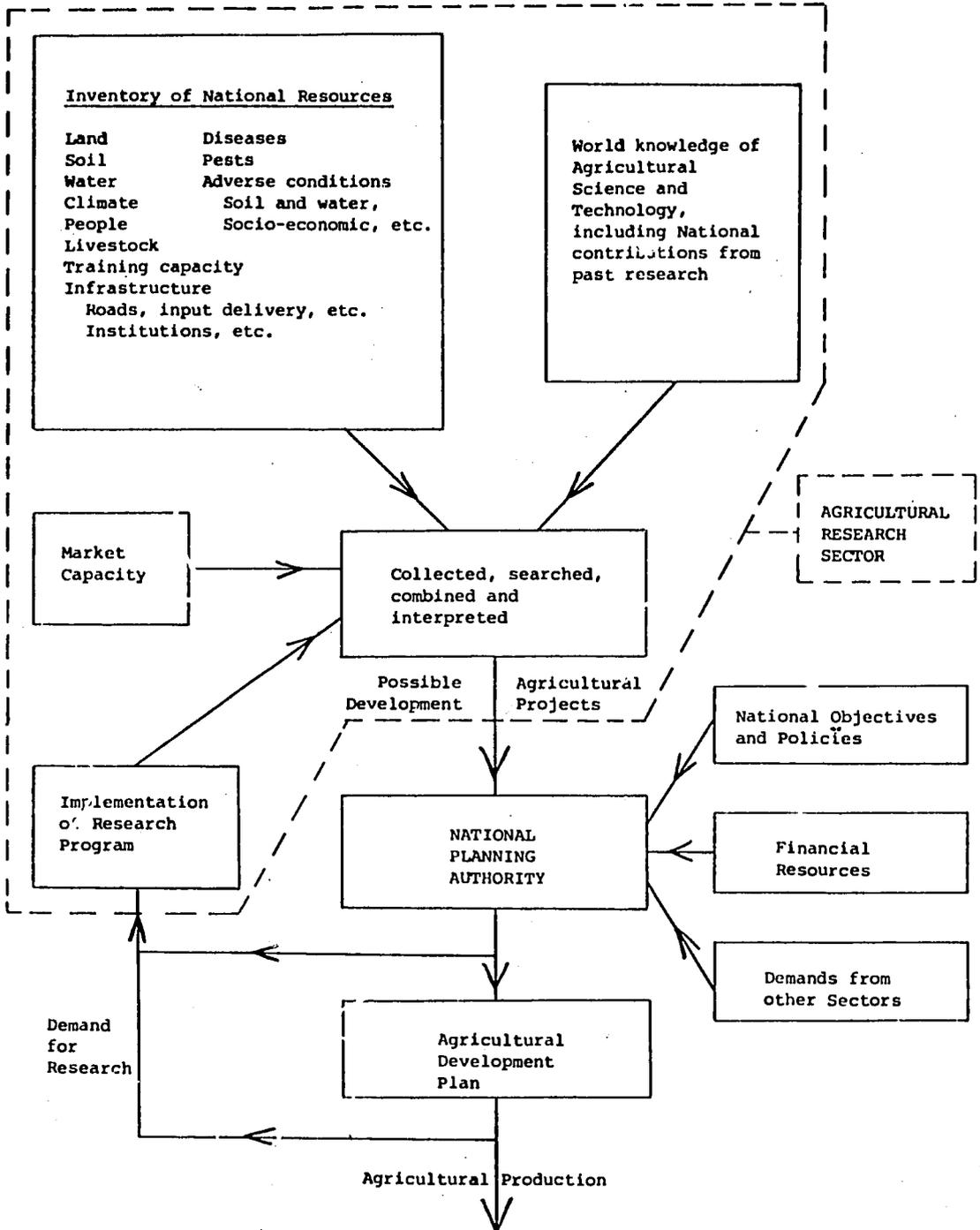
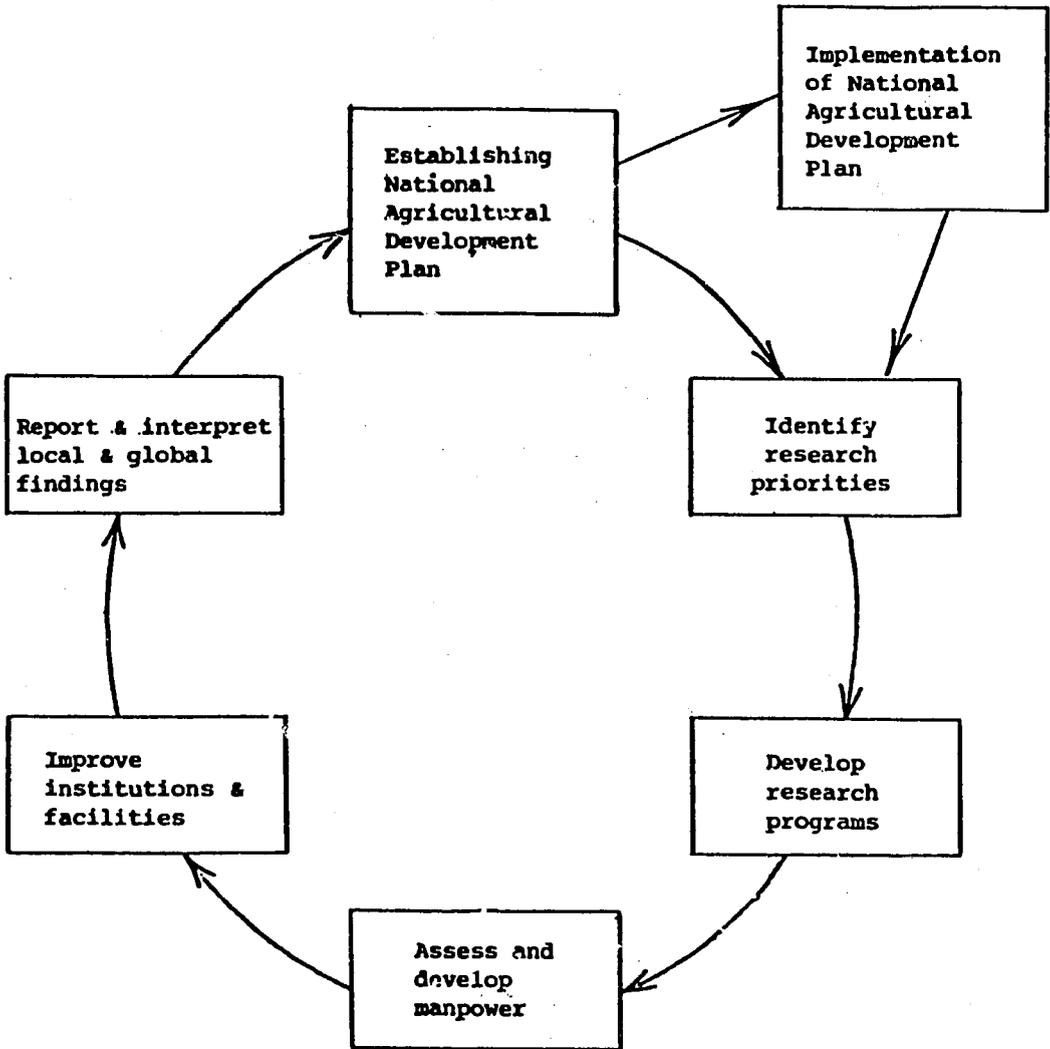


Fig. 3 Establishing the National Agricultural Development Plan
Role of Research System



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Fig. 4 Planning for Implementation of National Agricultural Research



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Fig. 5

PRESENT ORGANIZATION OF AGRICULTURAL RESEARCH IN KENYA

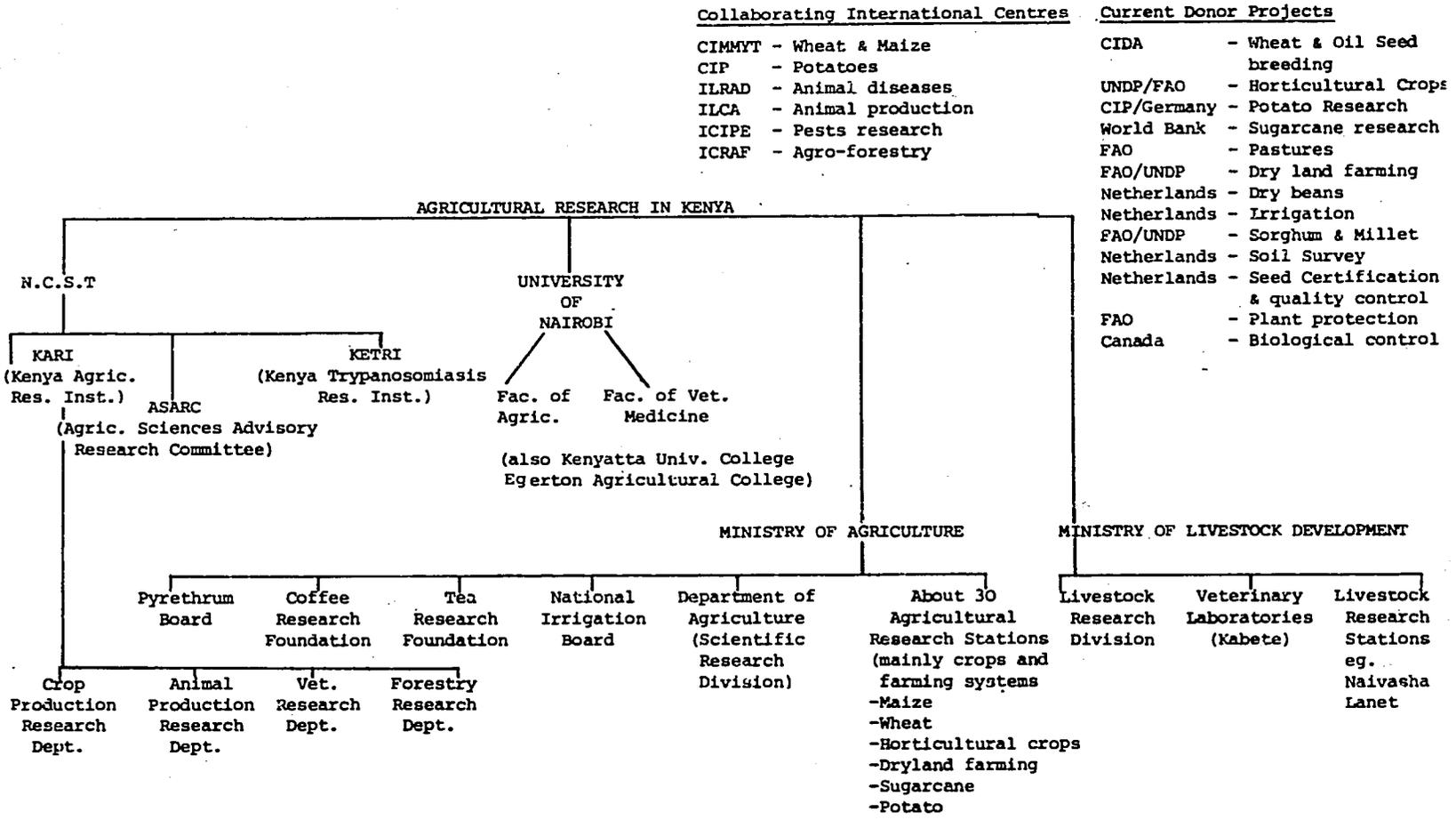
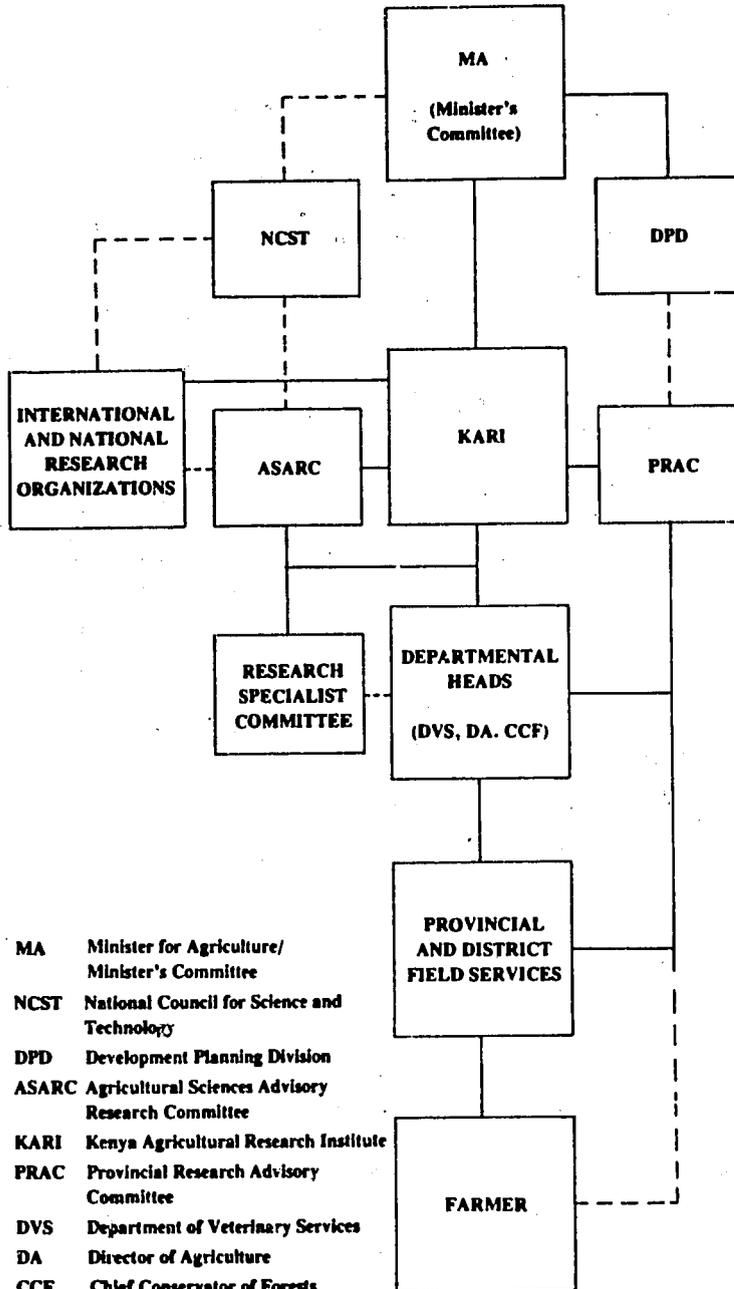


Fig. 5a

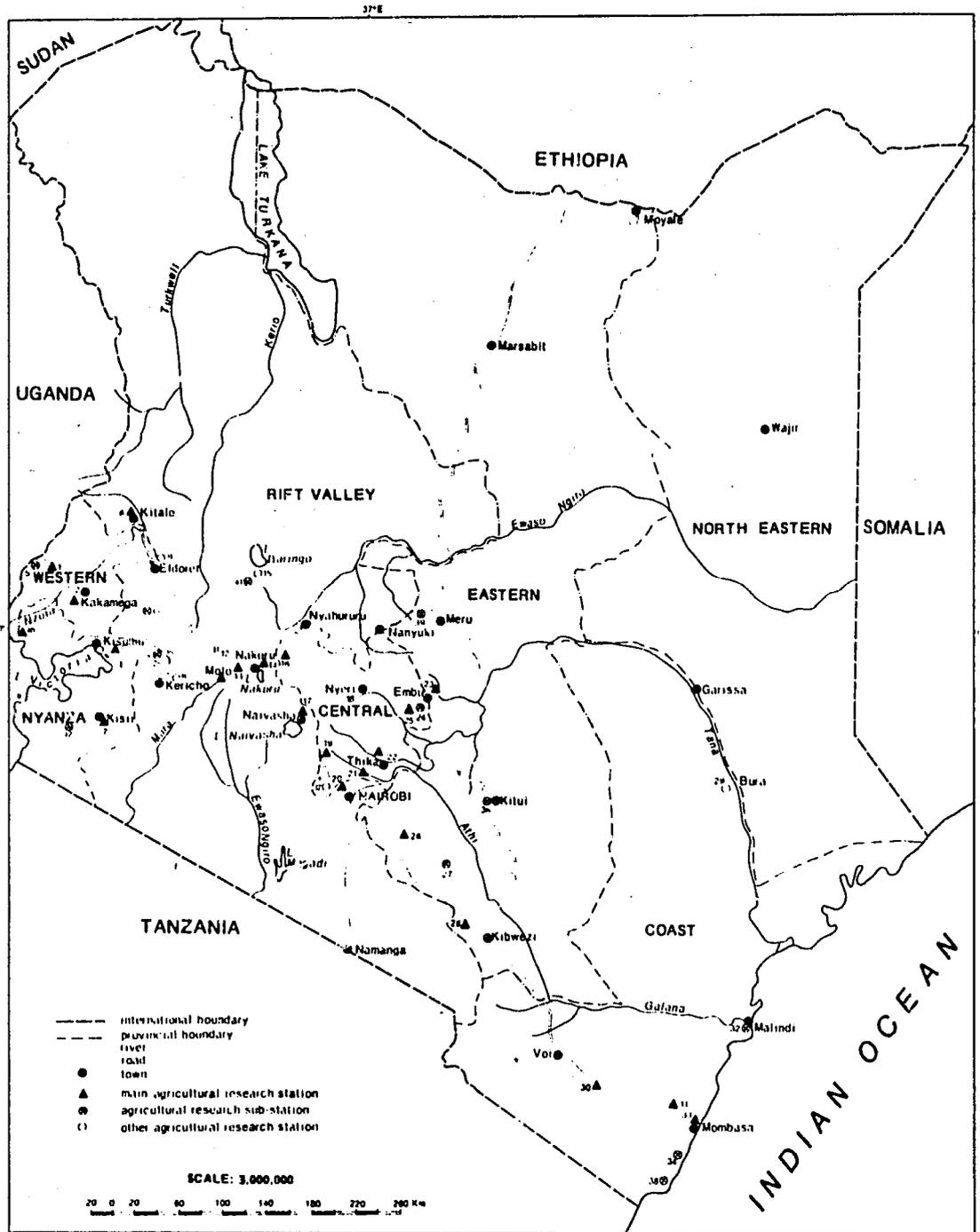
Inter-relationship and linkages of the Scientific Research Division



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Source : Agricultural Research System in Kenya by D.M. Thairu, SAREC Report R1 : 1980

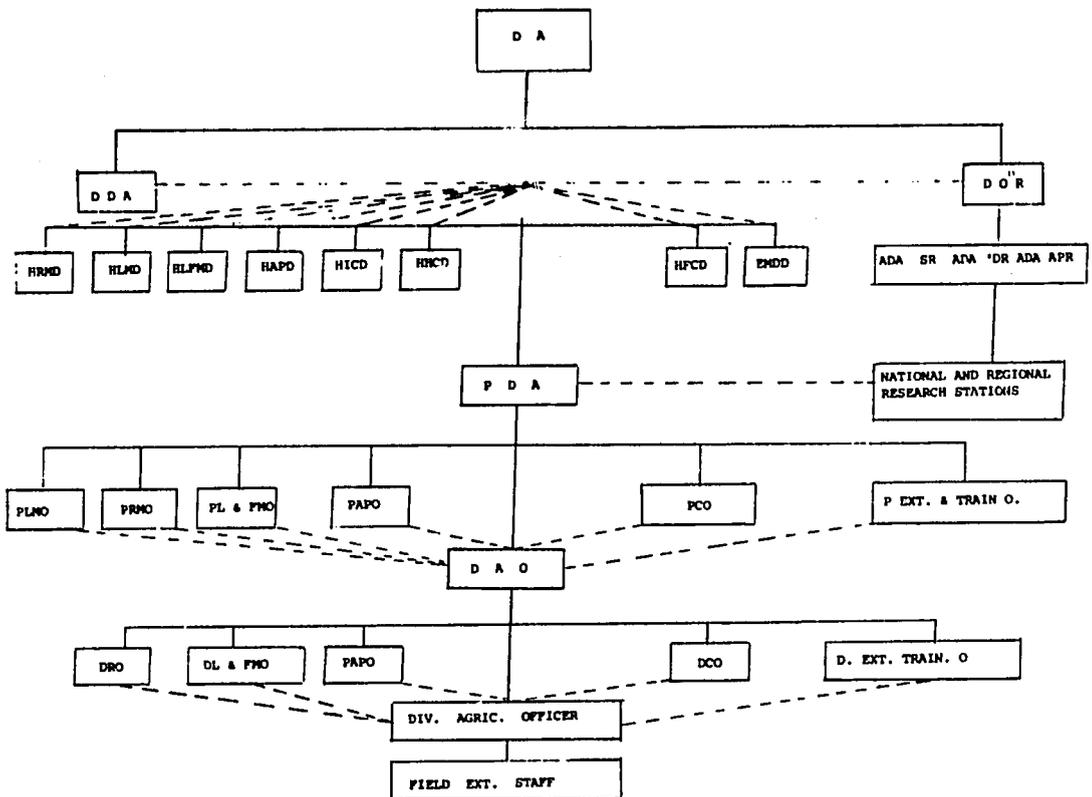
Fig. 6 Location of agricultural research stations and substations in Kenya.



Prepared and drawn by Kenya Soil Survey April, 1977
Drawing No. 77018

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Fig. 7 ORGANIZATION OF AGRICULTURAL RESEARCH AND EXTENSION SERVICES (AGRICULTURAL RESEARCH DELIVERY) UNDER THE DIRECTOR OF AGRICULTURE (DA)



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