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A Manpower and Training Plan for the Agricultural Research System in Kenya 1983-1987

Prepared By:

National Council for Science and Technology

and

International Service for National Agricultural Research

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SUMMARY

The first part of this report examines the development of the agricultural research system in Kenya since independence, and the main characteristics of the present stock of agricultural research scientists. The strong and continuing commitment to agricultural research by the government has resulted in very large increases in the employment of scientists and technical support personnel, although this growth has not occurred at a uniform rate throughout the period. Real expenditure on agricultural research has also increased rapidly, especially during the latter half of the 1970s. While less than 0.1% of agricultural GDP was allocated to agricultural research in 1970, by 1979 the target of 1% had been exceeded. Consequently the agricultural research system in Kenya is in a relatively strong position in terms of resource availability, as compared with most other developing countries.

The analysis of Kenyan agricultural research scientists currently in post indicates that while much has been achieved, much still remains to be done in order to ensure that Kenya's agricultural research system is able to meet the challenges of the decades to come. One of the major problems is the inexperience of the majority of agricultural scientists, which in the 1970s was exacerbated by high levels of attrition to other parts of the public sector and, to a lesser extent, the private sector. It is essential that young graduate recruits work with experienced scientists. They should also receive high quality postgraduate training once they have been employed for two to three years. With the recent large increases in graduate recruitment, the burden of providing adequate supervision and training has grown enormously. Approximately 50% of agricultural research scientists have still to go for M.Sc. training.

In spite of the rapid growth of the research system during the last 30 years, the analysis of unconstrained demands for additional research scientists and support personnel presented in Chapter 4 indicates that there are estimated to be serious shortages of scientific manpower in most of the major disciplines involved in agricultural research. To satisfy these requests would require at least a doubling of the number of research scientists. In order to assess the feasibility of such an increase, the probable growth in "effective demand" for agricultural scientists is estimated in Chapter 5 on the basis of a number of key assumptions about expenditure on agricultural research and the growth of agricultural GDP during the next 5 to 10 years. It is concluded that approximately 38 research scientists can, on average, be added to the total stock each year between 1983 and 1987. The allocation of these net additions to the main areas of research is dependent on the specification of future research priorities. On the basis of discussions with the National Council of Science and Technology and senior research personnel, in addition to analyses of past research priorities, the current and desired balance between basic, applied, and adaptive research, and the linkages which should exist between research and extension, it is recommended that the following allocations be adopted: crops, 15; forestry, 10; animal production, 11; and veterinary, 2.

These allocations must be seen, however, in the context of general personnel policy for agricultural research. Chapter 6 deals with issues of job categories, job grades, and academic qualifications. Particular attention is paid to the ability of the research institutions to pay for additional personnel.

In Chapter 7 the training needs of research personnel are identified, and strategies are proposed for meeting them. The importance of encouraging the correct attitudes towards agricultural research is emphasized, as is the need to create the necessary research and production skills. It is recommended that short courses at international agricultural research centers be greatly increased for young crops scientists, and that this should be followed by formal postgraduate M.Sc. training. Ph.D.-level training should also be available for highly competent research officers who are motivated and have demonstrated their commitment to pursuing a career in agricultural research. Finally, senior scientists who have established a good record of research productivity should be rewarded with opportunities to attend appropriate courses and workshops in their field of study. The issue of local versus overseas postgraduate training is also discussed.

Chapter 8 examines the current deployment of officers by commodity area, and allocates research manpower within this sector in accordance with research priorities identified by policy-makers and senior scientists. There was widespread agreement that the traditional food crops of Kenya have received too few resources and that research in these areas should be strengthened. In particular maize, sorghum and millet, the grain legumes cowpea and pigeon pea, and the rootcrops cassava and yams were identified as high priorities. In addition the oil seed crops, such as sunflower and rape seed are given high priority in order to reduce vegetable oil imports. Vegetable breeding work was also viewed as a priority (so that better adapted varieties could be developed for multiplication by the existing seed industry). Finally, some tree crops and tea need to be strengthened due to their importance to the economy of Kenya. In terms of crops research training, a comprehensive five-year plan, involving both short-term research training at international agricultural research centers (IARCs) and formal postgraduate degree training, primarily at the Faculty of Agriculture at the University of Nairobi, is proposed.

The next three chapters follow the same format for animal production, and veterinary and forestry research. First, the current deployment of research manpower is analyzed and then the recommended net additions of new research officers are allocated by program area and/or discipline. Finally, the training needs of current and new research officers are assessed, and a training plan proposed.

The adequacy of the projected supplies of B.Sc., M.Sc., and Ph.D. graduates from existing sources during 1983 to 1987, in relation to the recommended recruitment and postgraduate training requirements for the agricultural research sector, are examined in some detail. In crops research, the most urgent need is to expand the capacity of the Faculty of Agriculture, University of Nairobi, to train postgraduate students,

but in the meantime it will be necessary to increase overseas training opportunities. The first priority for animal production research is to establish a B.Sc. animal production program as quickly as possible, even though M.Sc. training requirements are still very large compared with recent outputs. Forestry research will only be able to recruit about half of its requirements for B.Sc. graduates from the Department of Forestry, and will have to rely considerably on recruitment from B.Sc. general science courses. Current plans for postgraduate forestry training remain unclear, and this should be rectified as soon as possible. Finally, while BVM graduate recruitment into veterinary research should remain relatively limited, the number of scientists currently employed who require M.Sc. and Ph.D. training is still substantial. It is recommended that much greater reliance be placed on the Faculty of Veterinary Medicine, University of Nairobi.

Chapter 12 considers actual and desirable ratios between scientists and technical support personnel. A number of measures are recommended to improve the performance and relative position of this manpower. Actual and projected supply of agricultural diploma- and certificate-holders is assessed in relation to estimated requirements between 1983 and 1987. It is concluded that given the current expansion of these training institutions, recruitment targets for agricultural research are attainable.

Chapter 13 summarizes the main conclusions and recommendations of this study.

CHAPTER 1

INTRODUCTION

Origin of the Mission

In 1981 the National Council for Science and Technology (NCST) and the International Service for National Agricultural Research (ISNAR) participated in a joint study of Kenya's national agricultural research system. One recommendation which resulted from this study called for a careful analysis of the manpower development requirements of Kenya's agricultural research system. On May 4, 1982, Professor P. Gacii, Permanent Secretary of the Ministry of Regional Development, Science, and Technology wrote to Dr. W. K. Gamble, Director General of ISNAR, to request that a definitive study of the manpower and training requirements of the Kenyan agricultural research system be carried out without further delay. It was proposed that this be a collaborative study between NCST and ISNAR. The Director General responded favorably to this request, and on June 4, 1982, an ISNAR team arrived in Nairobi to begin working with NCST.

Terms of Reference

The following terms of reference were developed by NCST and formed the basis of the review.

- Assess the present and future needs of Kenya for agricultural research manpower.
- Propose a program for manpower training and development to meet these needs, taking into account the numbers, areas, and levels of training required.
- Determine the need for technical and/or financial assistance required for agricultural research manpower development.
- Make any other recommendations considered necessary to strengthen Kenya's overall agricultural research manpower development.
- Prepare and submit the report to ISNAR and the Government of Kenya within six weeks of the start of the study.

Composition of the Mission

The review was carried out by a joint study team selected by the National Council for Science and Technology and ISNAR. Overall direction for the study was given by Dr. F. J. Wang'ati, for the Secretary of NCST. Professor Burton E. Swanson (ISNAR consultant, on secondment from the University of Illinois)) served as team leader. Other members of the study team included Mr. Paul Bennell (ISNAR consultant), Dr. A. Chabeda

(Ministry of Livestock Development), Dr. Jeff A. Odera (Forestry Research Department), and Dr. Byron Mook (ISNAR staff member). The study was coordinated by Dr. R. N. Oduwo (NCST). In addition, the team was assisted by many Kenyan policy-makers, administrators, and research scientists who shared data and insights about strengthening the manpower dimension of the Kenyan agricultural research system.

Program of the Mission

The ISNAR members of the mission visited Kenya from 4 June to 25 June 1982 to join with the NCST team members in conducting an on-site review of the manpower and training requirements of the agricultural research system. During July a first draft of the study was prepared, and from 3 September to 10 September the ISNAR team returned to Kenya to join with the NCST team to review the draft report with NCST officials and key policy-makers in the agricultural research system. The purpose of the follow-up review was to gain feedback to the draft manpower and training recommendations, so appropriate modifications could be made. During data collection and the follow-up review the study team met with the Director of the Kenya Agricultural Research Institute (KARI), the Chief Conservator of Forests, the Director of Research for the Ministry of Livestock Development, and the Director and Deputy Director of Research for the Ministry of Agriculture. The team also visited five national research stations and one regional station, and held extensive discussions with station directors and senior research scientists. In addition, the team discussed training issues with both the Dean of the Faculty of Agriculture and of Veterinary Medicine, as well as the Principal of Egerton College. Many additional people assisted the team by providing data and insights as to how the agricultural research system might be strengthened through manpower development and training. A list of the people met appears in Appendix 1.

Background Information

Since this report is a follow-up of the original study conducted a year earlier, no background information on Kenyan agriculture, agricultural development, or the agricultural research system has been included here. The reader is directed to this original report for detailed background information on agricultural research in Kenya.

CHAPTER 2

BACKGROUND INFORMATION ON AGRICULTURAL RESEARCH MANPOWER IN KENYA

National and Agricultural Manpower Planning in Kenya

National Manpower Surveys

The need for comprehensive and systematic manpower planning has been consistently identified by the Government of Kenya as being critical to determining the size and composition of the skilled manpower required to meet the social and economic objectives laid down in each of the five-year development plans. However, this commitment has still to be effectively translated into practice. Of the three national manpower surveys which have been undertaken since Uhuru (independence) in 1963, only the first was published (in 1964) and proved to be of any significant value in the overall planning process.

In the absence of adequate manpower survey data, manpower planners in Kenya have been obliged to rely upon other sources of information which, because they have been collected for more general planning purposes, can only provide a fragmentary and insufficiently detailed statistical picture of trends in the supply, demand, and utilization of skilled manpower. In order to remedy this situation, a program to fully integrate and institutionalize the manpower planning function within the central planning machinery has been outlined in The Fifth Five Year Plan 1978-1983. However, it still remains to be implemented.

Agricultural Manpower Surveys

Two major agricultural manpower plans have been undertaken during the last 20 years. The first was incorporated into The Report of The Agricultural Education Commission (chairman J.R. Weir) published in 1967 which, on the basis of a survey of unconstrained demands of major public and private sector employers of agricultural graduates, recommended that a faculty of agriculture should be established at the University of Nairobi, with an undergraduate output of 40 students per year. This recommendation was accepted by the Government of Kenya, and the new Faculty of Agriculture accepted its first students in 1970. It soon became apparent, however, that the Weir Commission had seriously underestimated the level of effective demand for agricultural university graduates. With respect to the agricultural research sector, the commission arbitrarily assumed that there would be only a 20% increase in all staff categories by 1980. Hence an increase was envisaged of crop and animal research scientists from 82 in 1966 to 120 by 1980. As will be discussed below, there were at least 400 agricultural research scientists in Kenya by 1980!

Eleven years later, the second agricultural manpower survey, commissioned by the United States Agency for International Development (USAID) and

undertaken by consultants from the American Technical Assistance Center (ATAC), produced professional and subprofessional agricultural manpower projections for 1978 to 1988. These projections are increasingly considered to be overinflated. Moreover, for the purposes of this report, the ATAC survey is of limited value not only because it is in urgent need of updating (which we understand is being considered at the moment), but, more important, because it did not separately delineate high and middle level manpower requirements for the agricultural research sector.

In view of the unreliability of earlier agricultural manpower projections, it is understandable that there is some skepticism among senior agricultural research personnel in Kenya concerning the value of manpower planning exercises. In part this is also attributable to the widely held view that "everything is changing so quickly" in the agricultural research system that it is not possible to plan effectively. While we understand these views, it is still necessary to formulate operational manpower development policies for the agricultural research system in Kenya. These must be based on a detailed assessment of the current situation and the most desirable strategies for the future given the nature of the constraints that are likely to prevail.

Data and Methodology Problems

The National Council for Science and Technology has initiated what are intended to be ongoing survey and other information-gathering activities which will provide the core data necessary for a systematic appraisal of the agricultural research system in Kenya. A survey of scientists and technicians employed in all sectors of the economy was completed in 1976 and, in 1981, a set of three questionnaires was circulated to all agricultural research stations in an attempt to obtain wide-ranging data on research programs and projects in the country. The response to this postal survey has been generally very good, and it constitutes one of the most valuable sources of data that can be utilized in assessing the manpower situation in the agricultural research sector.

In spite of the significant improvement in agricultural research manpower data in recent years, there are still a number of gaps and inconsistencies in the information that we collected from a wide variety of sources. While we have been able to overcome some of these problems, many could not be surmounted in the limited time available, and this has inevitably complicated the task of formulating the more quantitative aspects of the manpower and training plan for the agricultural research system.

Further improvement could be made with more study, but the essential magnitudes are not likely to be changed, and the illustrative nature is considered valid.

Effective manpower planning is dependent upon the prior specification of future patterns of resource allocation at the sectoral and program levels. As will be discussed more fully in Chapter 5, a consensus is beginning to emerge among both agricultural scientists and national policy-makers concerning which areas of agricultural and related research should be accorded priority in the future allocation of resources. However much remains to be done before it will be possible to ascertain with any real precision the future requirements for agricultural research manpower.

The Determination of Future Manpower Requirements: An Overview

Three manpower planning methodologies have been widely employed in both developed and developing countries since the early 1960s:

1. International comparisons of the manpower situation in different countries in order to derive common patterns of manpower development. Studies of this kind frequently employ multivariate statistical techniques and are generally undertaken at a high level of occupational/skill aggregation. It is arguable therefore, whether such a mode of analysis is applicable to such a specialized and, in many respects, unique group as agricultural scientists and their support personnel. Nevertheless broad international comparisons are useful in gaining a better understanding of the relative position of the agricultural research system in Kenya in terms of various size indicators vis-à-vis other countries.

2. Manpower projections based on the extrapolation of past trends in the growth of occupations within a country. Again, it would be unsound to base the analysis of future agricultural scientific manpower requirements solely upon this particular technique, not only for the reason stated above (that agricultural research manpower has peculiar characteristics), but also because the inherent assumption that past events are a good basis from which to predict the future is difficult to sustain, especially in a country such as Kenya which has experienced dramatic social and economic transformations during the last 20 years.

3. The most popular manpower planning technique has been the use of sample surveys of employers in each of the major sectors of an economy. Employers are simply requested to estimate their additional occupational requirements over a specified period. The methodological limitations of surveys of this kind are manifold given that they are based on the often diverse subjective opinions of respondents. Ideally, common criteria should be adhered to by respondents in their evaluations of what is desirable and what is likely to be feasible in view of the economic constraints to which they are subject in varying degrees. As will be discussed in Chapter 6, the need to differentiate between what can be termed "unconstrained" and "constrained" manpower projections is of paramount importance. This is especially so when the public sector is the major employer of a particular occupation (like research scientists) since the gap between the two sets of estimates has often been found to be much greater than it is among private sector employers who are generally more aware of their "ability to pay" for additional manpower.

International Comparisons with the Agricultural Research System in Kenya

The Overall Position of Kenya

In comparison with other less developed countries (LDCs), Kenya has committed considerable resources to its agricultural research system both

in terms of expenditure and manpower deployment. Although time-series data which are necessary for analyzing trends in the development of agricultural research systems among LDCs are unavailable, it is clear that Kenya has had a relatively strong agricultural research system at least since the early 1950s. In 1967 the Weir Commission concluded that "It is generally acknowledged that Kenya has the strongest agricultural research services of any independent African country."

Table 1 was derived from data presented by Oram and Bindlish in their 1981 report entitled Resource Allocations to National Agricultural Research. From the 51 LDCs for which sufficiently detailed information was available, it can be seen that Kenya was:

- In fourteenth position with respect to total 1980 expenditure on agricultural research;
- In seventh position with respect to agricultural research expenditure per million people. Per capita expenditure on agricultural research in Kenya is approximately double the global LDC average;
- In eighth position with respect to the number of agricultural research scientists per million people;
- In fourth position with respect to the percentage of agricultural GDP allocated to the agricultural research system.

Within Sub-Saharan Africa, Kenya still has the highest number of agricultural scientists per million people (24.3 compared with continent-wide averages of 15.1 for Sub-Saharan Africa, 15.2 for Asia, and 22.7 for Latin America), and is only surpassed by oil-rich Nigeria in terms of research expenditure per capita.

The Relative Number of Postgraduate Agricultural Scientists

Postgraduate study by agricultural research scientists is generally considered to be of critical importance for the development of viable research programs. It is worthwhile, therefore, to examine the numbers of Kenyan agricultural scientists who have acquired postgraduate qualifications at the M.Sc. and Ph.D. levels, and then to compare the Kenyan situation with that prevailing in other LDCs. From Table 2 can be seen that including all agricultural research scientists working at national, regional, and international research stations in Kenya yields a combined M.Sc. and Ph.D. percentage of 77.3%, which, compared with the 30 other LDC countries from which Oram and Bindlish were able to obtain comparable data, is only exceeded by Bangladesh! While subtracting the large number of scientists employed at the international research centers (in particular ILRAD and ICIPE) reduces this percentage to 56.9% for both Kenyans and foreigners and 47.9% for Kenyans alone, the national agricultural research system in Kenya is still better endowed with postgraduate scientific manpower as compared with the 30 other LDCs in the Oram and Bindlish sample. A separate set of qualification data presented by Wang'ati for 1979 to 1980 does not diverge appreciably from this figure. Finally, our 1982 estimates give a combined M.Sc. plus Ph.D. percentage of 45.4% for Kenyan agricultural scientists. (This figure for postgraduates includes those officers who are currently taking postgraduate courses, but the total manpower base includes the very large intake of B.Sc. graduates in 1981).

Table 1. Expenditure Allocation and Manpower Development to National Agricultural Research Systems, 1980.

	Ag. Research Expenditure Actual 1980 ($000)	Rank	Population 1978 ('000)	Ag. Research Expenditure per Million People	Rank	Number of Ag. Scientists per Million People	Rank	Ag. Research Expenditure at % of Ag. GDP	Rank
1. Expenditure over $50 million									
Brazil	160,026	1	126,377	1,266	4	23.4	8	1.15	3
Argentina	108,648	2	4015	1	1	39.3	2	1.64	1
India	101,098	3	693,887	145	15	10.2	14	0.29	12
Nigeria	79,634	4	77,082	1033	6	14.1	12	0.70	6
Mexico	54,181	5	69,994	774	8	18.1	11	0.65	8
2. Expenditure $10-40 million or over 1000 scientists									
Colombia	31,455	6	26,907	1169	5	12.3	13	0.67	7
Indonesia	29,056	7	151,894	191	13	9.7	15	0.44	10
Malaysia	29,023	8	13,640	2127	2	60.4	1	0.81	5
Venezuela	25,586	9	14,914	1715	3	24.5	6	1.32	2
Korea Rep.	18,962	10	37,979	499	9	25.3	5	0.23	14
Bangladesh	17,385	11	88,705	195	12	18.5	10	0.48	9
Thailand	15,203	12	47,674	318	10	31.9	4	0.26	13
Pakistan	16,510	13	82,441	200	17	35.2	3	0.41	11
Kenya	14,204	14	16,402	865	7	24.3	7	1.08	4
Philippines	8,769	15	50,996	172	14	20.5	9	0.16	15

Source: Derived from data presented in P.A Oram and V. Bindlish, Resource Allocations to National Agricultural Research: Trends in the 1970s, ISNAR/IFPRI, Nov. 1981.

Table 2. Formal Qualification Levels of Agricultural Research Scientists in Kenya Compared with other LDCs, 1978 to 1982

	Year	Nationality	Total	B.Sc.	M.Sc.	Ph.D.	(M.Sc.+ Ph.D)%	Number of LDC Countries Where (M.Sc.+ Ph.D.)% Greater
Kenya (inc. IARCs[1] + univ)	1978	Kenyans & Foreigners	529	173 (32.7)	193 (36.5)	163 (30.8)	77.3	1/30
Kenya (exc. IARCs + univ)	1978	Kenyans & Foreigners	334	144 (43.1)	144 (43.1)	46 (13.8)	56.9	4/30
Kenya (exc. IARCs + univ)	1978	Kenyans	244	127 (52.0)	102 (41.8)	15 (6.1)	47.9	7/30
Kenya (Wang'ati estimate)	1979-1980	Kenyans & Foreigners	304	165[2] (54.2)	88 (28.9)	51 (16.7)	45.6	7/30
Kenya (ISNAR/NCST estimate)	1982	Kenyans	566[3]	284 (50.1)	242[4] (42.7)	15[4] (2.6)	45.4	7/30

Notes:
(1) IARCs = international agricultural research centers. The International Laboratory for Research in Animal Diseases (ILRAD) and the International Center of Insect Physiology and Ecology (ICIPE) have their headquarters in Nairobi.
(2) Reads "107" in the text but summary B.Sc. totals by research sector yields 165.
(3) These figures include the 100+ graduates recruited in 1981 and also agricultural research scientists in training at local and overseas institutions. Qualifications obtained by 42 scientists could not be ascertained so qualifications are expressed as percentages of 525-42=486.
(4) Scientists currently undertaking M.Sc. and Ph.D. courses are also included in these totals.

Source: 1978 Data: B.M. Jamieson, Resource Allocation to Agricultural Research in Kenya from 1963 to 1978, (Ph.D. thesis, Toronto University, 1981).
1979 to 1980: F. J. Wang'ati, "Allocation of Resources to Agricultural Research: An Inventory of the Current Situation in Kenya," (mimeo, NCST, 1981).

The Growth of the Agricultural Research System in Kenya, 1963 to 1982

The Growth in Manpower

Two main sources of information have been utilized in order to derive time-series estimates of the numbers of Kenyan and foreign scientists engaged in agricultural research since independence in 1963. Jamieson presents detailed data on stock of scientists employed at all agricultural research stations for every year between 1963 and 1978 which, in addition, is also further disaggregated by formal academic qualifications. There are, however, considerable divergences in the stock figures for more recent years as these have been presented in various papers and reports. In order, therefore, to obtain the most detailed and up-to-date assessment that was possible of the number and characteristics of agricultural research scientists employed in Kenya in mid-1982, we decided to undertake our own survey relying primarily on staff lists obtained from the Ministries of Agriculture and Livestock Development and the Kenya Agricultural Research Institute (KARI). This was supplemented by the information on individual research scientists contained in Questionnaire B of the NCST 1981 survey and graduation lists from the University of Nairobi; numbers and names of scientists who are currently undertaking, or who recently completed, postgraduate courses were obtained from the Directorate of Personnel Management, the British Council, and USAID. All scientists were separately card indexed and then entered into a computer for analysis. Details of the methodology and data analysis of this survey are presented in Appendices 2 and 3.

Both Jamieson's and our 1982 data have been combined in Tables 3 and 4. It is possible to delineate three broad time periods: 1963 to 1972, 1973 to 1978, and 1978 to 1982.

1963 to 1972

Colonial neglect of secondary and tertiary education in Kenya prior to the early 1950s meant that at the time of independence there were only 18 Kenyan agricultural research scientists with university degrees. The massive commitment of the Kenyatta government after 1963 to education and, in particular, the provision of formal training for high and middle level manpower resulted in a rapid expansion in the numbers of Kenyan agricultural research scientists to 158 in 1972, nearly all of whom had to attend overseas universities due to the absence of local training in agricultural subjects. In contrast to the small numbers of Kenyan scientists in the early 1960s, there was a sizeable cadre of expatriate scientists (mainly from Britain) who staffed the research stations, the numbers of which had increased significantly during the 1940s and 1950s (see Table 5). The need for this expatriate manpower continued to grow in the 1960s so that, taken together, there was a rapid increase in the stock of Kenyan and expatriate agricultural research scientists between 1963 and 1972 -- from 125 to 344.

1973 to 1978

While the average annual rate of growth in the number of Kenyan agricultural scientists declined sharply during this period, the average absolute increase in the stock per year in the six years up to and

Table 3. Number of Agricultural Research Scientists in Kenya, 1963 to 1972.+

Year	KENYANS					FOREIGNERS					GRAND TOTAL
	B.Sc.	M.Sc.	Ph.D.	Subtotal	(M.Sc. + Ph.D.)%	B.Sc.	M.Sc.	Ph.D.	Subtotal	(M.Sc.+Ph.D)%	
1963	12	3	3	18	33.3	57	20	30	107	46.7	125
1964	17	4	3	24	29.2	57	16	25	98	41.8	122
1965	17	9	5	31	45.2	57	22	28	107	46.7	138
1966	24	13	3	40	40.0	69	25	44	122	56.6	162
1967	30	22	4	56	46.4	70	33	34	137	49.9	193
1968	32	22	7	61	47.5	56	33	44	133	57.9	194
1969	47	23	6	76	38.2	65	42	46	153	57.5	229
1970	54	29	8	91	41.8	64	50	46	160	60.0	251
1971	74	35	12	121	38.4	64	54	54	172	62.8	294
1972	93	56	9	158	41.1	67	62	57	186	64.0	344
1973	81	66	14	161	49.7	54	62	56	172	68.6	333
1974	92	69	19	180	48.9	46	54	54	154	70.1	334
1975	98	75	17	190	48.4	42	54	60	156	73.1	346
1976	101	76	14	191	47.1	30	46	44	120	75.0	311
1977	116	77	16	209	44.5	28	46	32	106	73.6	315
1978	127	100	15	242	47.5	17	42	31	90	81.1	332
1982	284*	242*	15*	566**	45.4	n.a.	n.a.	n.a.	72	n.a.	638

+ As will be discussed in Chapter 3, these figures do not included members of the faculties of agriculture and veterinary medicine at the University of Nairobi.

* Includes agricultural scientists currently undertaking M.Sc. and Ph.D. degrees, and expressed as percentages of 486 (See explanatory note, Table 2).

** Includes 25 scientists whose formal qualifications could not be identified.

Table 4. Average Annual Growth Rates and Percentage Increases in Agriculture Research Scientists Employed in the Public Sector in Kenya, 1963 to 1982.

		KENYANS		FOREIGNERS		TOTAL	
Source and Years		Av. Annual Growth Rate	% Increase	Av. Annual Growth Rate	% Increase	Av. Annual Growth Rate	% Increase
Jamieson	1963-72	27.3	777	6.3	74	11.9	175
	1972-78	7.4	53	-0.86	-51	0.99	-3
	1963-78	18.9	1244	-0.98	-16	6.7	166
Jamieson/ ISNAR/ NCST	1978-1982	22.6	134	-0.95	-20	16.8	92
	1963-1982	19.7	3044	-0.98	-33	8.8	410

Source: B.M. Jamieson op. cit and ISNAR/NCST, 1982 Manpower Survey.

Table 5. Establishment of Agricultural Research Stations in Kenya, 1900 to 1982.

1900-1920	1921-1940	1941-1960	1961-1970	1971-1982
2	3	13	4	2

Source: Computed from data in B.M. Jamieson, op. cit.

including 1978 was still about the same as the corresponding annual increase between 1963 and 1972. The other significant development was the halving of the number of expatriate agricultural research scientists working in Kenya from 186 in 1972 to only 90 in 1978. This loss was not quite compensated for by the increase in the number of Kenyan scientists, so that there were marginal decreases in the total stocks of scientists during these years.

1978 to 1982

The lack of growth in overall numbers of agricultural research scientists between 1972 and 1978 has been followed by a period of unprecedented expansion. According to our survey, there were approximately 566 Kenyan graduates employed in the agricultural research system in June 1982. The increase in over 300 scientists since 1978 can mainly be accounted for by the very large intakes of B.Sc. (agriculture), B.Sc. (science), and BVM veterinary graduates -- approximately 50 in 1979, 41 in 1980, and 120 in 1981, a combined total of 211 over three years. The remaining residual of 80 scientists (i.e., 566 minus 239 minus 211) can at least in part be explained by the fact that it is likely that those research scientists undertaking full-time postgraduate courses in 1978 were not included by Jamieson in her stock estimates. Our data indicate that these individuals in training constitute a sizeable proportion of scientists in the research system. For example, we estimate that over 100 agricultural scientists commenced postgraduate courses between 1979 and 1982. A more detailed analysis of the 1982 stock of agricultural scientific manpower will be presented in Chapter 3.

Proportions of B.Sc., M.Sc., and Ph.D. Degree-Holders, 1963 to 1978

It is useful to consider briefly the changes that have occurred in the formal qualification levels attained by Kenyan and foreign agricultural research scientists in Kenya between 1963 and 1978. In column 1, Table 6, it can be observed that the ratio of M.Sc.- to B.Sc.-holders has changed significantly -- from 0.3:1 in 1963 to nearly 1:1 in 1978. This can be attributed to the strong commitment by those in charge of the agricultural research system in Kenya to the objective of ensuring that all young B.Sc. and BVM graduates undertake M.Sc. courses after two or three years of on-the-job experience at research stations. However, the situation with regard to Ph.D. trainees has been markedly different as

can be seen from columns 2 and 3, which show the extent to which the ratios of B.Sc.- and B.Sc.-plus-M.Sc.- to Ph.D.-holders have deteriorated especially since 1973. Whereas there was one Ph.D. scientist to every three other scientists in the 1960s, this had fallen to 1:6 by 1978. Furthermore, if only Kenyans are considered (see Table 3), the ratio of Ph.D. level scientists to other agricultural scientists was only 1:16 in 1978, declining to 1:38 by 1982. In view of the critically important role of Ph.D. scientists in conducting research, and supervising and offering leadership to their junior colleagues, this large reduction in the proportion of scientists with Ph.D.s has serious implications for both the quantity and quality of research that can be undertaken, and also for the effectiveness of training programs.

Table 6. Ratios of B.Sc.: M Sc.: Ph.D. Agricultural Research Scientists in Kenya, 1963 to 1978 (Kenyans and Foreigners).

QUALIFICATION YEAR	M.Sc./B.Sc.	Ph.D./B.Sc.	Ph.D./(B.Sc. + M.Sc.)
1963	23/69= 0.3	33/69= 0.48	33/92= 0.36
1968	55/88= 0.6	51/88= 0.58	51/143= 0.36
1973	128/135=0.95	70/135= 0.52	70/263= 0.27
1978	142/144=0.98	46/144= 0.32	46/286= 0.16

Source: Computed from data presented in B.M. Jamieson op.cit.

Past Trends in The Increase of Agricultural Scientists: A Basis for Extrapolation?

By expressing the percentage increase in the number of agricultural research scientists in Kenya between 1963 and 1978 as a ratio of the percentage increase in national output measured in constant prices during the same period, we obtained an estimate of the elasticity of demand for agricultural research scientists with respect to national output. If it is assumed that the future pattern of demand for agricultural research scientists will not differ from what it has been, then the elasticity of demand statistic can be used to estimate future manpower requirements. The elasticity of demand for agricultural research scientists in Kenya with respect to GDP is 1.42, which means that a 1% increase in real output will result in a 1.42% increase the number of agricultural research scientists employed. If we accept recent official estimates that the Kenyan economy will grow at an average rate of 4.3% per annum in real terms during the 1980s, then the percentage increase in GDP between 1978 and 1988 will be 53.8%; hence the rise in the stock of agricultural research scientists will be 53.8 x 1.42 = 76%, or 252 in absolute terms.

The serious limitations of basing manpower requirements on these extrapolation techniques are strikingly apparent when it is recalled that the stock of agricultural scientists in Kenya increased by at least 200 -- probably nearer 300 -- between 1978 and 1982! Given, therefore, the disjointed pattern of growth in the numbers of agricultural research

scientists during the last 20 years, we can conclude that it is not practical to estimate future manpower requirements on the basis of extrapolations of past rates of manpower growth.

Growth in Expenditure

Two sets of time-series data on national and agricultural research expenditure are presented in Tables 7 and 8. While the reasons for the divergences in the annual expenditure figures given by Jamieson and Wang'ati are not clear, both reveal the very substantial increases in expenditures in national and agricultural research during the 1970s. Expressed in constant prices, the average annual rate of growth of agricultural research expenditure was 18.4% between 1973 and 1978. The sharp increases in 1977 and 1978 were due to the incorporation of the East African Agricultural and Forestry Research Organisation and East African Veterinary Research Organisation, which previously had been East African Community Institutions, into the national research system. There was also a steady increase in the number of Kenyan scientists employed during this period.

As can be seen from Table 8, expenditure on agricultural research was only 0.22% of agricultural GDP in 1970, but this percentage had increased to 1.06% by 1979. Research expenditure in other areas increased at an even faster rate, so the percentage allocation of agricultural research in total national research expenditure fell from being over 90% in the early 1970s to 74% by 1979. We understand that this percentage is likely to fall still further as Kenya strives to achieve the policy target level of 1% of national GDP allocated to all research activities.

Table 7. Agricultural Research Expenditure from 1973 to 1978 in Current and Constant (1972) Prices.

	Expenditure (Current Prices)	Annual Rate of Growth (%)	Expenditure (Constant 1972 Prices)	Annual Rate of Growth (%)
1973	2,097,919	-	1,951,063	
1974	2,363,251	12.6	1,866,908	-4.3
1975	2,596,637	9.3	1,869,579	0.1
1976	3,485,041	34.2	2,160,725	15.6
1977	6,483,328	86.0	3,306,497	53.0
1978	7,764,151	19.8	4,541,210	37.3
			Average Annual=	18.4

Source: B.M. Jamieson op. cit.

Table 8. National and Agricultural GDP and Research Expenditures, 1970 to 1979.

Year	(1) GDP[1] (K£, millions)	(2) Agriculture[2] GDP (K£, millions)	(3) National Expenditure Research (K£)[3]	(4) Expenditure Agricultural Research (K£)	3/1 (%)	4/2 (%)	4/3 (%)	2/1 (%)
1970	515.51	171.8	396,607	391,507	0.08	0.22	99	33.3
1971	570.06	178.5	232,851	207,424	0.04	0.11	89	31.3
1972	666.22	210.4	1,422,138	1,405,711	0.21	0.66	99	31.6
1973	749.64	268.9	2,259,074	2,132,708	0.28	0.79	94	35.8
1974	963.32	324.80	3,031,945	2,901,101	0.32	0.89	96	34.3
1975	1052.64	352.23	3,287,108	2,931,955	0.31	0.83	89	33.4
1976	1296.14	472.39	4,259,433	3,668,383	0.32	0.77	86	36.4
1977	1680.54	674.90	8,279,410	5,726,292	0.49	0.85	69	40.1
1978	1788.65	639.98	8,936,422	6,374,553	0.50	0.99	71	35.8
1979	1979.62	639.48	9,509,032	7,010,672	0.48	1.06	74	33.3

(1) GDP at factor cost measured in current prices.
(2) Also includes forestry production.
(3) Based on government estimates of expenditure and therefore excludes research expenditure by private companies and international institutions.

Source: GDP data: Statistical Abstracts (various), Central Bureau of Statistics, Ministry of Economic Planning and Development; and Research Expenditures: Wang'ati op. cit.

CHAPTER 3

PRESENT CHARACTERISTICS OF THE STOCK OF AGRICULTURAL RESEARCH SCIENTISTS BY DISCIPLINES AND CROPS, JUNE 1982

The following discussion will outline the present deployment of agricultural research scientists within the major areas of agricultural research in Kenya, namely crops, forestry, animal production, and veterinary medicine. The tables which will be presented are largely self-explanatory and are intended as a source of reference. We do not propose, therefore, to give detailed descriptive analyses, but merely to summarize the most salient features of the prevailing patterns of employment.

Crops Research

From Table 9, it can be seen that there are 385 agricultural scientists undertaking crops research at 9 national and 10 regional research stations (these are listed in Appendix 3). All but 18 of these scientists could be identified by discipline. The four principal disciplines of breeding and genetics, agronomy, plant pathology, and entomology accounted for 15.6%, 19.2%, 13.2%, and 13.5%, respectively, of the total number of Kenyan crop scientists. Approximately 54% of crop scientists have only a B.Sc. degree and 39.7% have received or are currently acquiring M.Sc.-level training. The corresponding figure for Ph.D. degrees is only 2.6%. The general inexperience of Kenyan crop scientists is clearly apparent: 45.7% have less than three years experience and 67.5% have less than five years experience.

The breakdown of crop scientists by major crop improvement programs is presented in Table 10. Over 140 scientists could not be classified in this way, of which at least 100 are engaged in general disciplinary research in such areas as soils, pests and diseases, plant nutrition, soil physics, and irrigation, which are not specifically concerned with crops. With the important exceptions of maize and grain legumes, research on each crop is the responsibility of just one or, in a few cases, two research stations. Research on the major export crops (tea, coffee, pyrethrum) accounts for less than 11% of total crop scientists. The three largest concentrations of research manpower are in wheat, barley and triticale (14.5%), horticulture (16.5%), and maize (13.6%), accounting for nearly 45% of all crop scientists.

There are 39 expatriate scientists engaged full-time in crops research. The discipline breakdown is as follows: breeders, 6; agronomists, 7; soils, 2; entomologists, 6; pathologists, 7; irrigation, 1; agricultural economics, 3; and other agriculture, 7.

Forestry Research

Only 18 Kenyan scientists are engaged in forestry research. Approximately 50% of forestry research scientists have only B.Sc. (science) (11.1%) and B.Sc. (agriculture) (38.9%) degrees, and 38.9% have

Table 9. Stocks, Qualifications, and Experience Profiles of Crops Research Scientists by Major Discipline in Kenya.

	Total Number		Highest Qualification Attained (Kenyans)*					Known Postgraduate Training 1980-83		Work Experience (Years) (Kenyans)					
Discipline	Kenyan	Foreign	BGn	BAg	MSc	PhD	?	MSc	PhD	0-2	3-4	5-6	7-10	10+	?
Breeding and Genetics	60	7	18	9	29	2	2	11	0	24	15	5	6	8	2
Agronomy and Plant Physiology	74	7	13	23	36	1	1	9	1	33	21	5	6	8	1
Soils and Plant Nutrition	34	1	17	0	13	1	3	3	0	16	4	3	3	4	4
Soil Physics, Minerology, etc.	21	0	11	2	8	0	0	1	0	11	4	0	3	1	2
Entomology	52	6	25	2	24	1	0	5	1	21	13	3	10	2	3
Plant Pathology	51	7	23	15	21	2	0	7	1	25	9	6	1	5	5
Soil and Water Conservation	9	0	6	1	1	1	0	0	1	7	0	0	0	1	1
Irrigation	14	1	3	5	5	0	1	0	0	7	5	0	1	1	0
Ag. Economics/Sociology, etc., and Biometrics	28	3	11	6	9	0	1	5	0	16	6	2	2	1	1
Food Science and Technology	5	0	2	4	0	0	0	0	0	2	2	1	0	0	0
Chemistry	12	0	8	1	0	0	0	0	0	7	3	1	0	1	0
Others (inc. admin.)	7	0	1	1	2	2	1	0	0	1	1	1	0	4	0
Not Specified	18	7	6	5	2	0	5	1	0	6	1	1	0	0	10
Totals	385	39	144	64	153	10	14	31	4	176	84	28	32	36	29

* Includes all staff currently in training at the degree level they will achieve upon return.

Table 10. Number of Scientists in Major Crop Improvement Programs by Qualification Level.

Commodity	B.Sc.	M.Sc.	Ph.D.	?	Total	% of Total
Maize	8	12	2	1	33	13.6
Wheat, Barley, Triticale	16	18	1	0	35	14.5
Sorghum, Millet	5	6	0	0	11	4.6
Horticulture	24	15	0	1	40	16.5
Grain Legumes	9	10	0	0	19	7.9
Roots and Tubers	8	5	0	1	14	5.8
Oil Seeds	2	5	0	0	7	2.9
Cotton	9	10	0	0	19	7.9
Coffee	3	10	1	1	15	6.2
Sugar	13	2	1	0	16	6.6
Pyrethrum	3	4	0	0	7	2.9
Tea	1	2	1	0	4	1.7
Seeds	11	6	0	0	17	7.0
Rice	4	0	0	0	4	1.7
Totals	126 (52.3)	105 (43.6)	6 (2.5)	4 (1.6)	241	(100.0)

obtained or are presently acquiring an M.Sc. (see Table 11). Work experience data is only half complete, and it is unwise to try to draw any conclusions from this. No expatriate scientists are employed in forestry research in Kenya, but it is likely that there will be three or four within the next three years.

Animal Production Research

Only 65 Kenyan scientists were identified as being actively engaged in animal production research at six research stations. Discipline breakdowns disaggregated by highest qualifications attained and years of work experience are presented in Table 12. It can be observed that 44.6% of these scientists have only B.Sc. degrees, while 49.2% have acquired or are currently studying for the M.Sc. Some seven (10.8%) have acquired postgraduate qualifications during the last three years or are currently acquiring them.

In terms of work experience, 49% of animal production scientists have less than five years (as compared with 68% of crop scientists) - though it should be pointed out that experience data for 9% of animal production scientists could not be ascertained.

Approximately 11 expatriates are involved in animal production research (genetics, nutrition, production, etc., 3; forage and pasture, 2; range

Table 11. Stocks, Qualifications, and Experience Profiles of Forestry Research Scientists by Major Discipline, May 1982.

	Total Number		Highest Qualification Attained (Kenyans)*					Known Postgraduate Training 1980-83		Work Experience (Years) (Kenyans)					
Discipline	Kenyan	Foreign	BGn	BAg	MSc	PhD	?	MSc	PhD	0-2	3-4	5-6	7-10	10+	?
Silviculture	5	0	0	2	2	1	0	0	0	0	0	0	3	0	2
Dryland Afforestation	3	0	0	2	1	0	0	0	0	1	0	0	0	0	2
Forest Mensuration	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0
Forest Products Res.	2	0	1	0	1	0	0	0	0	0	0	0	0	0	2
Entomology and Zoology	2	0	0	1	1	0	0	0	0	1	0	1	0	0	0
Forest Pathology	3	0	1	1	0	1	0	0	0	0	0	0	0	1	2
Forest Fires Res.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed Research	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0
Other Forestry	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Totals	18	0	2	7	7	2	0	4	0	3	2	1	3	1	8

* Includes all staff currently in training at the degree level they will achieve upon return.

Table 12. Stocks, Qualifications, and Experience Profiles of Animal Production Research Scientists by Major Discipline, June 1982.

Discipline	Total Number		Highest Qualification Attained (Kenyans)*					Known Postgraduate Training 1980-83		Work Experience (Years)					
	Kenyan	Foreign	BGn	BAg	MSc	PhD	?	MSc	PhD	0-2	3-4	5-6	7-10	10+	?
Breeding and Genetics	5	1	0	3	2	0	0	0	0	2	0	0	1	1	1
Animal Nutrition	11	1	1	3	7	0	0	0	0	3	3	2	1	1	1
Reproductive Physiology	2	0	0	1	0	0	1	0	0	0	1	0	1	0	0
Production and Management	11	0	2	3	5	0	1	0	0	3	2	0	3	3	0
Forage and Pasture Improvement	22	3	4	6	11	0	1	0	0	7	3	2	5	3	2
Range Management/ Ecology	8	5	3	1	3	0	1	0	1	3	1	0	2	0	2
Not Known/Admin.	6	1	0	2	4	0	0	0	0	3	1	0	1	1	0
Totals	65	11	10	19	32	0	4	6**	1	21	11	4	14	9	6

* Includes all staff currently in training at the degree level they will achieve upon return.
** Distribution not known.

management, 5; other or not known, 1). This excludes those expatriate scientists employed on the United Nations Development Programme/Food and Agriculture Organization Sheep and Goats Project (which is not within the Research Division) and the CRSP Small Ruminants Project.

Veterinary Research

A total of 98 Kenyan veterinary research scientists was recorded as being employed at the two main research laboratories at Kabete (which also includes the Foot-and-Mouth Research Laboratory at Embakasi and four regional veterinary investigation laboratories, VILs), and at KARI, Muguga. As with animal production scientists, it was not possible to obtain discipline breakdowns for slightly more than one-third of the veterinary research scientists (many of whom work at the VILs), but the qualification data are reasonably complete.

There is a well established training program for veterinary research scientists as can be seen from Table 13, where 50 (51%) of the total have or are currently acquiring M.Sc. and Ph.D. qualifications. It should be noted, however, that only three veterinary researchers obtained their M.Sc.s more than three years ago. This relative inexperience of veterinary research scientists (60% are known to have less than five years experience) is the major constraint to the development of research capacity, and creates serious problems for effective on-the-job training and supervision. Thus, the 21 expatriate veterinary scientists who are employed have a crucial role to play in strengthening the capacity of the veterinary research system.

The University of Nairobi

While the primary task of members of the faculties of agriculture and veterinary medicine is to teach under- and postgraduate students, research activities have always been considered an essential element of the overall objectives of these institutions. However, as will be discussed later, understaffing and a general lack of resources has meant that most faculty members have been able to devote only a relatively small part of their time to research endeavors. It is mainly for this reason that we have not included the 62 faculty of agriculture and 80 faculty of veterinary medicine staff members (in 1980/81) in the analysis of the current and projected research manpower situation in the agricultural research system in Kenya.

Attrition and Turnover of Agricultural Research Scientists

In order to derive estimates of projected requirements for agricultural research scientists in Kenya, it is necessary to determine the "wastage" or attrition of this manpower from the research system. For the purposes of this report, the rate of attrition over a specified period will be defined as the average annual number of research scientists who die, retire, or resign to take up employment outside of the agricultural research system, expressed as a percentage of the initial stock of scientists. The rate of turnover, on the other hand, measures the extent

Table 13. Stocks, Qualifications, and Experience Profiles of Veterinary Research Scientists by Major Disciplines, June 1982.

	Total Number		Highest Qualification Attained (Kenyans)					Known Postgraduate Training 1980-83		Work Experience (Years)					
Discipline	Kenyan	Foreign	BGn	BVM	MSc	PhD	?	MSc	PhD	0-2	3-4	5-6	7-10	10+	?
Bacteriology	17	1	2	4	9	1	1	9	0	9	2	0	1	0	5
Biochemistry	4	1	1	1	2	0	0	0	2	3	0	0	0	0	1
Helminthology	9	0	1	1	6	1	0	5	0	6	1	0	0	0	2
Pathology	8	0	0	1	6	0	1	4	0	2	2	0	1	1	2
Protozoology	9	1	0	2	6	0	1	6	0	3	1	1	0	0	4
Immunology	4	1	0	2	1	0	1	0	0	1	0	1	0	0	2
Virology	6	3	1	0	5	0	0	5	0	0	1	0	0	0	5
Wildlife	4	0	0	4	0	0	0	na	na	4	0	0	0	0	0
Other Veterinary (incl. VILs*)/ Not Known	37	14	4	14	15	1	3	18	1	20	4	1	3	0	9
Totals	98	21	9	29	50	3	7	47	3	48	11	3	5	1	30

* VILs = Veterinary Inspection Laboratories.

to which agricultural research scientists leave or are transferred from their present research stations to take up positions elsewhere in the agricultural research system.

There is widespread agreement among senior research personnel and government manpower and management analysts that the extremely high turnover and attrition of research scientists employed in the agricultural research system constitutes one of the most serious constraints in the development of an effective research capability in Kenya. Indeed, a report on agricultural research commissioned by USAID in 1977 went so far as to state that "the primary problem facing the Scientific Research Division (SRD) of the Ministry of Agriculture is that of the attraction and retention of competent staff." Such high levels of instability clearly mitigate against the establishment of a "critical mass" of experienced scientific manpower within the system as a whole and at specific research stations.

While rates of return to investment in the training of agricultural scientific manpower have been high in both developed and less developed countries, these returns have been generated by groups of scientists who have generally remained in the agricultural research system throughout their working lives. Expressed slightly differently, formal training for agricultural research is highly "specific" in that the skills acquired can normally only be effectively utilized within the agricultural research system. High rates of attrition also mean that correspondingly high rates of recruitment of university graduates must be sustained in order to ensure the preservation of stocks of manpower. In situations of limited supply, this clearly poses a serious problem.

Estimates of Attrition and Turnover from Previous Reports

In spite of the unanimity of views that prevail concerning the high levels of attrition and turnover of agricultural research scientists in Kenya, little systematic quantitative evidence has been presented. Most commentators have relied upon fragmentary, often highly qualitative data in order to derive rough estimates or orders of magnitude. These data are, however, of some value for the purposes of this report.

The previously cited USAID Report on Agricultural Research in Kenya found that of the 188 research scientists employed by SRD in 1974, 58 resigned during the next three years to take up jobs with other ministries, the university, or private industry. From these figures, we can calculate that the average annual attrition rate was 10.3% during this period. The report concluded that: "It is evident that the Research Division is used as a training ground for young graduates who, as soon as they have gained some experience, seek jobs elsewhere." Similarly, the Second IBRD Integrated Agriculture Development Programme (IADP) Staff Appraisal Report in 1979 stated that "The SRD has suffered from a massive turnover of technical personnel in recent years," and cited the findings of the evaluation mission that of the eight stations visited only one had a station director who had been in position for more than two years. The Dean of the Faculty of Agriculture at The University of Nairobi stated in an interview with us that the attrition of young research scientists is still very serious as is evidenced by the fact that 8 of the 18 students recently sponsored by ministries to undertake M.Sc. programs at the faculty departed for jobs in the private sector once they had completed their training. Finally, recruitment and retention problems facing more

remote research stations are often far worse compared with those stations located in or near Nairobi, which in the opinion of a recent NCST report face "few problems" in retaining staff. The recent decision to upgrade experienced Egerton-trained technical officers at the National Range Research Station at Kiboko is symptomatic of the extreme reluctance of young university graduates to work in what are remote and uncomfortable locations, particularly if they have families.

ATAC and ISNAR/NCST Estimates

While the above examples would appear to provide irrefutable evidence of high rates of attrition and turnover among agricultural research scientists, more detailed and systematic analysis tends to reveal a less serious situation. First, the ATAC agricultural manpower survey for Kenya estimated that overall attrition of "B.Sc.+" personnel within the Ministry of Agriculture as a whole between 1978 and 1983 would be 3.3%, yielding an average annual attrition rate of 0.66%. This is clearly much too low. In order, therefore, to obtain more reliable estimates of attrition and turnover among agricultural research scientists we have drawn on three separate sets of data. First, we compared the 1979 SRD research station staff lists with our 1982 listing of crop scientists in order to ascertain how many scientists can no longer be traced and who, therefore, can be presumed to have left the agricultural research system altogether and how many have been transferred to other research stations during this three-year period. The results of this exercise are presented in Table 14, where it can be observed that the national and regional station turnover rates are 2.7% and 3.8%, respectively, and the corresponding attrition rates are 4.2% and 7.6%. There do appear, therefore, to be quite important differences in the patterns of scientist job mobility between national and regional stations although both types of station are equally dispersed geographically around the country. And the one research station within SRD located in Nairobi, the National Agricultural Laboratories, has had relatively high turnover and attrition rates.

The second set of estimates has been derived by analyzing how many of the 1977 B.Sc. (science) intake into SRD in 1977 still remained in the agricultural research system in 1981. Of the 18 recruits, 5 had left according to our data, yielding an average annual attrition rate over what will be considered a four-year period of 26.9% divided by 4 = 6.72%. Information on the job movements of maize breeders and agronomists and pasture research scientists between 1963 and 1979 contained in the very interesting report of the Ad Hoc Committee on Maize and Pasture Research provides another source of useful information, although comparable attrition and turnover rates cannot easily be determined given the complex patterns of recruitment of these scientists during a 15-year period. In Table 15 it can be seen that 19% of all graduate recruits to these programs at the National Agricultural Research Station, Kitale, during 1963 to 1979 were transferred to other research stations (although 62% of this group remained within the national research programs) while 30.9% left the agricultural research system altogether. However, it is interesting to note that the "internal brain drain" of agricultural research scientists to the private sector was less than 10% for these three research programs.

Table 14. Turnover and Attrition of Kenyan Research Scientists in Crops Research, 1979 to 1982.

STATION	Left Station 1979 - 1982		Turnover (i.e. Left to Other Station)		Attrition (i.e. Left Research System)	
	No.	%	No.	%	No.	%
NATIONAL						
Katmani, NDLRS	0/4	0.0	0	0.0	0	0.0
Kitale, NARS*	5/15	33.3	4/15	26.7	1/15	6.7
Njoro, NPBS	2/16	12.5	0/16	0.0	2/16	12.5
Tigoni, NPBS	na	---	na	---	na	---
Kibos, NSRS	4/14	25.6	2/14	14.3	2/14	14.2
Lanet, NSQCS	1/5	20.0	0/5	0.0	1/5	20.0
Nairobi, NAL	9/35	25.7	2/35	5.7	7/35	20.0
Thika, NHRS	2/23	8.7	1/23	4.3	1/23	4.3
Subtotal	23/112	20.5	9/112	8.0	14/112	12.5
Av. Annual Rates	--	6.8	--	2.7	--	4.2
REGIONAL						
Embu, ARS	1/4	25.0	0/4	0.0	1/4	25.0
Kakamega, WARS	1/3	33.3	1/3	33.3	0/3	0.0
Kisii, NARS	0/3	0.0	0/0	0.0	0/0	0.0
Mtwapa, CARS	2/10	20.0	0/10	0.0	2/10	20.0
Molo, PHRS	4/6	66.6	1/6	16.7	3/6	50.0
Kibos, CARS	3/5	60.0	2/5	40.0	1/5	20.0
Nyandarua Ol Joro Orok, ARS	1/2	50.0	0/2	0.0	1/2	50.0
Mwea-Tebere, ARS	0/4	0.0	0/4	0.0	0/4	0.0
Subtotal	12/35	34.4	4/35	11.4	8/35	22.8
Annual Rates	---	11.4	---	3.8	---	7.6
	35/147	(23.8)	13/147	(8.8)	22/147	(15.0)
Av. Annual Rates	--	7.9	--	2.9	--	5.0

* Includes forage agronomy section now under Ministry of Livestock Development.

Source: Ministry of Agriculture, 1979 Staff Lists for Agricultural Research Stations: and ISNAR, 1982 Manpower Survey.

Table 15. Turnover and Attrition of Research Scientists in Maize and Pasture Research at the National Agricultural Research Station, Kitale, 1963 to 1979.

				TURNOVER			ATTRITION					
DISCIPLINE	Total Recruited	Still in Post	Departures	Transfer (Within Maize/ Pasture Programs)	Transfer (Non-maize/ Pasture Programs)	Total	Private Sector	University	Int. Res. Centers/ CRF	Other Public.	Other/ D.K.	Total
Maize, Breeding	13	5	8	2	2	4	2	0	1	0	1	4
Maize, Agronomy	11	6	5	0	0	0	1	1	1	1	1	5
Pasture Research	18	10	8	3	1	4	1	1	1	0	1	4
Totals	42	21	21	5	3	8	4	2	3	1	3	13
	100	50	50	11.9	7.1	19.0	9.5	4.8	7.1	2.4	7.1	30.9

Source: Report of the Ad-Hoc Committee on Maize and Pasture Research, February 1980.

Although no precise data are available, it is well known that attrition among young graduate recruits into the agricultural research system has been very high in the past. However, since the majority of these losses occur during the first three to six months of employment, they do not constitute a serious loss in terms of formal training expenditure and on-the-job experience. If, therefore, they are excluded from the calculations, the three sets of data discussed above indicate that the rate of attrition among agricultural research scientists in the early 1980s is approximately 6% to 8% per annum. While this is still a high figure, it is considerably less then the rates of attrition implied by the examples cited earlier.

The Rate of Attrition in the 1980s

Many factors must be taken into account in determining the likely rate of attrition of agricultural research scientists during the next 5 to 10 years. One set of factors relates to the internal functioning of the research system, which in turn is determined by the nature of the organizational structure, quality of research management, terms and conditions of service for research personnel, and patterns of promotion. Improvements in any one of these areas will lead to lower rates of attrition and/or turnover of research scientists. Given the importance of these aspects of the research system, we shall consider them in some detail in Chapter 6.

The second set of factors concerns developments at the national level in the labor markets for agricultural and science graduates. Analyzing these factors seems to suggest that, on balance, it is likely that the rate of attrition for agricultural research scientists will fall (as indeed it has been doing since the mid-1970s) if it is assumed that the USAID attrition estimate of 10.3% is correct. This is because the exceptionally high level of (effective) excess demand for agricultural and, to a slightly lesser extent, science graduates during the 1970s in Kenya is unlikely to prevail once localization requirements in the public and private sectors have been attained. In other words, the demand for these graduates will become increasingly dependent on increases in economic growth (especially in the private sector). The Weir Commission of 1967 underestimated private sector demand (a total of only 70 of the additional 680 agricultural graduates from the new Faculty of Agriculture was considered sufficient to satisfy private sector demand up until 1980), and hence attrition rates were much higher than expected during the 1970s. However, the ATAC Agricultural Manpower Survey concluded that the "commercial sector" will only account for 10.3% of additional requirements of B.Sc.+ (agriculture) manpower between 1978 and 1988 as compared with the 20.8% of the total stock of Kenyan agricultural graduates employed in the private sector in 1977. Similarly the appraisal of the Fourth Education Project undertaken by IBRD in the late 1970s stated that "The effective demand for trained manpower in the private sector is currently high, but it is expected that within 3-4 years, it will fall, thus requirements for the private sector are not expected to be significant."

On the supply side, local training of university-level agricultural manpower was not established until 1970, and it is not surprising, therefore, that there was such a pent-up demand for the new graduates

from both the public and private sectors when they first entered the labor market in the mid-1970s. However, plans are now well advanced to double the output of B.Sc. (agriculture) graduates from the University of Nairobi, which should have a major impact in meeting this demand.

In conclusion, we shall assume that the rates of attrition for agricultural research scientists will continue to be in the region of 5% to 7% during the 5- and 10-year plan periods under consideration.

CHAPTER 4

UNCONSTRAINED DEMAND FOR AGRICULTURAL RESEARCH SCIENTISTS IN KENYA

The most common approach by manpower planners to ascertaining national manpower requirements has been to undertake sample surveys of employers. While a number of improvements have been introduced in the structure and administration of "manpower requirement" questionnaires in an attempt to overcome some of the most serious problems which have arisen, their principal value in the formulation of manpower plans lies mainly in gauging broad orders of magnitude of perceived needs for different types of manpower. Moreover, these unconstrained manpower needs can only be realized to the extent that the necessary manpower is available (the supply constraint) and that employers have the financial and absorptive capacities to employ the additional people they claim they require (the effective demand constraint). As mentioned earlier, the distinction between perceived need and effective demand is of particular importance where the public sector is the major employer of a particular type of manpower. In terms of satisfying the needs of the population for food, education, health care, transport, and recreation, the additional requirements of skilled manpower are enormous for all societies, but especially among developing countries. But clearly, most governments are seriously constrained both in their capacity to train and subsequently employ all the manpower that is required.

The ATAC and DPM Surveys of Unconstrained Demand

The ATAC Report on Professional and Subprofessional Agricultural Manpower in Kenya in 1977 is the most detailed survey of skilled agricultural manpower to have been undertaken in the post-independence period. However, while all major employers of professional and subprofessional agricultural manpower were interviewed by a survey team, the report does not distinguish agricultural research personnel from other types of manpower employed by the Ministry of Agriculture and "Other Public Sector," most notably those engaged in the agricultural extension function. In view of the unique characteristics and role of the agricultural research system in Kenya, we recommend that this survey be updated, and that greater attention be focused on the delineation of manpower requirements (by occupation, formal qualification levels, etc.) within the major divisions/departments of the Ministries of Agriculture and Livestock Development, and other ministries and government bodies concerned with agricultural development. The additional benefits that would be derived from undertaking a more detailed survey are illustrated in a more recent USAID report on agricultural manpower requirements in Tanzania, where since the agricultural research sector was clearly delineated, its unconstrained manpower needs can be examined both in absolute terms and in relation to other subsectors.

In spite of the limitations of the ATAC survey, it does reveal the very large demands for additional agricultural manpower by the Ministry of Agriculture and other public sector agencies in Kenya. In Table 16 it can be observed that the additional unconstrained demands for B.Sc.-holders exceeded 1977 stock levels by 200% during 1978 to 1988, and

Table 16. Additional Agricultural Manpower by Qualification Level Requested by the Public and Private Sectors in Kenya, 1977 to 1988.

	In Post (IP) 1977	Additional Staff Requirements 1977	As % IP 1977	1983	As % IP 77	1988	As % IP 77
Public Sector							
M.Sc.	101	9	9	261	258	468	463
B.Sc.	740	246	33	1217	164	1953	263
B.Sc.+	841	255	30	1478	175	2421	288
Diploma	1399	451	32	1684	120	2681	191
Certificate	4399	3198	73	8404	191	11,194	254
Commercial Subsector							
M.Sc.	23	11	48	37	160	62	269
B.Sc.	198	29	14	172	87	216	109
B.Sc.+	221	40	18	209	94	278	126
Diploma	3338	30	9	617	182	969	286
Certificate	238	233	98	413	173	572	240
Grand Total							
M.Sc.	124	20	16	298	240	530	427
B.Sc.	938	275	29	1389	149	2169	231
B.Sc.+	1062	295	27	1687	159	2699	254
Diploma	1737	481	27	2301	132	3650	210
Certificate	4637	3431	74	8817	190	11,766	254

Source: Computed from ATAC Report on Professional and Sub Professional Manpower in Kenya, March 1977.

this increases to 400% for M.Sc.-holders. A manpower survey of the civil service undertaken by the Directorate of Personnel Management in 1979 also found that total "desirable" establishment levels for 1979 and 1983 greatly exceeded post-1979 employment totals for most high and middle level agricultural occupations (see Table 17). However, while the percentage increase for agricultural officers is approximately the same as the equivalent B.Sc.+ manpower category in the ATAC study, the divergence of estimates at the diplomate/assistant agricultural officer level appears to be extremely large (120% ATAC, 2567% DPM). This serves to highlight the inherent dangers of placing too much reliance on individual employer estimates of unconstrained manpower requirements.

Unconstrained Demands for Agricultural Research Scientists in the 1980s

Two sources of data have been utilized in estimating the overall size of unconstrained manpower requirements in the agricultural research sector. The first is an assessment of agricultural research scientist requirements in the crops, forestry, animal production, and veterinary subsectors by KARI in 1980. Since this report is the most comprehensive study of agricultural research manpower requirements, we have relied heavily on its findings.

Submissions by individual research stations to the 1981 and 1982 ISNAR/NCST missions are the second source of information on future manpower requirements. However, in the absence of a standard questionnaire format and standardized assessment criteria, it is difficult to interpret the information contained in these submissions and to derive sector-wide manpower requirement estimates.

Crops Research

The KARI manpower requirement estimates for crop research scientists are presented in Table 18. No time period is specified but we understand that these requirements relate to optimum levels of employment for at least the next five years. More important, it must be stressed that these are requirement estimates for experienced agricultural research scientists, all of whom should have postgraduate qualifications, five or more years of experience, and be capable of conducting their own research projects. In order to gauge the extent to which the KARI national crop manpower requirements exceed current staffing levels, we have compared them with the 1982 total stock figures for each of the major crops and disciplines and also, since we are dealing with experienced scientists, the numbers of crop scientists who have at least an M.Sc. (including those who are currently in training at this level) and those who have five or more years experience. This latter information allows the size of existing manpower deficits in terms of qualifications and/or experience to be calculated.

The KARI report identifies crop and related disciplinary research scientists requirements of 180 and 92 respectively, a total of 272. Our manpower survey revealed that approximately 150 scientists in the crops research subsector have or are currently acquiring M.Sc. and/or Ph.D. qualifications, leaving a current M.Sc. shortfall of 120, which is broken down by discipline for all crops research scientists in Table 19. It

Table 17. High and Middle-Level Agricultural Manpower Requirements in the Kenyan Civil Service 1979 to 1983.

CADRE	Number in Post 1979 Kenyan	Foreign	Desirable Estab. 1979	Desirable Estab. 1983	Additional Supply Required
Agricultural Officers	527	20	825	1,233	706
Asst. Agricultural Officers	796	3	10,549	20,438	17,736
Veterinary Officers	247	9	298	750	503
Animal Husbandry Officers	62	0	150	362	300
Lab. Technologists	401	13	939	1425	1024

Source: Directorate of Personnel Management, Survey of Manpower Requirements in The Kenyan Civil Service, 1980 (unpublished).

Table 18. KARI Estimates of National Requirements of Experienced* Scientists by Major Crop.

	Genetics and Breeding	Agronomy/ Horticulture	Pathology	Weed Science	Entomolcgy	Total
Maize	9	10	1	2	1	23
Wheat	3	3	3	1	1	11
Rice	3	3	2	2	2	12
Phaseolus Beans	4	-	3	-	3	10
Cowpeas	3	-	2	-	-	5
Potatoes	3	2	2	-	-	7
Fruits		10	3	-	2	15
Bananas and Plantains	-	5	1	-	-	6
Vegetables	-	10	2	-	-	2
Surgarcane	4	5	2	1	2	14
Sorghum	2	2	-	-	-	4
Millet	3	-	-	-	-	3
Triticale	2	-	-	-	-	2
Cassava	1	3	-	-	-	4
Sweet Potato	1	2	-	-	-	3
Pyrethrum	2	2	1	-	-	5
Cotton	3	4	2	2	4	15
Cashew Nut	2	2	-	-	..	4
Coconut	2	2	-	-	-	4
Oil Seeds	2	5	-	-	-	7
Barley	1	1	-	-	-	2
Misc. Pulses	4	2	-	-	-	6
Misc. Root Crops	1	2	-	-	-	3
Special New Crops	2	1	-	-	-	3
Total	57	76	24	8	15	180

* Experienced scientists have been defined as an officer with at least an M.Sc. degree and five years of research experience.

Source: Kenya Agricultural Research Institute, Organization of the Kenya Agricultural Research Institute, 1980.

Table 19. In-Post and KARI Requirement Estimates for all Crop Research Scientists,* early 1980.

Discipline	Total B.Sc. In Post 1982	In Post (Known) M.Sc. + 1982	Total* KARI National Requirement	Deficit
Breeder	60	31	68	37
Agronomist	74	37	87	40
Pathologist	51	23	31	8
Entomologist	52	25	24	1
Soil Science	55	22	18	-4
Irrigation	14	5	7	2
Economist/Biomet.	28	9	12	5

* i.e., Crops and disciplinary researchers.

Source: KARI, op. cit.

would appear that on the basis of the KARI estimates, the provision of postgraduate training for agronomists followed by plant breeders are the most critical areas of concern. For most of the other major disciplines the training deficit is less serious. In Table 20, the training deficits for the four core disciplines involved in research on major crops in Kenya have been ranked so that rough priorities for postgraduate training can be established. Crops below the 0-0 line in each discipline column already have sufficient M.Sc.+ scientists. The table demonstrates the complexity of establishing detailed manpower requirement estimates for each specific crop. Commodity-by-commodity analysis is necessary, as we have attempted in Chapter 8. Wheat, for example, is the only crop which is relatively well endowed with M.Sc.+ qualification-holders in most of the major disciplines.

It is the relative inexperience of agricultural research scientists that poses the greatest problem for the agricultural research system in Kenya. There is no instant remedy to this problem as far as the development of a local scientific cadre is concerned. With only 68 of the 385 Kenyan graduates engaged in crops research in Kenya having more than six years experience, it appears that experienced expatriate scientists can continue to play an important role which should, however, be increasingly oriented towards the training function per se rather than an overriding concern with specific scientific research problems.

The KARI study does not specify the number of both experienced and inexperienced research scientists required for crop research activities. There are already enough graduates employed who could be upgraded to postgraduates, and it is for this reason that some senior research personnel believe that the primary objective is to consolidate current stocks by upgrading rather than to continue recruiting relatively large numbers of fresh graduates. For example, the Committee on Maize and Pasture Research argued that: "The greatest contributions to success have come from a few qualified scientists, highly sensitive to the needs of the farmer, and who have worked devotedly for long periods on research problems. Although we were impressed by the substantial increase in the numbers of Kenyan research scientists since independence, we were concerned that this apparent improvement in quantity has not been reflected in meaningful research productivity during the 1970s."

The manpower requirements submitted by individual research stations to the ISNAR/NCST missions are summarized in Table 21. Despite the fragmentary nature of this data, it is apparent that most research station directors have higher estimates of projected research scientists than the 1980 KARI report. The broad estimates for additional requirements for experienced crop scientists are deemed to be 100% to 200% higher than 1981 employment levels, which on the basis of current staffing levels for crops research means between 220 and 440 new recruits.

Table 20. Relative Training Deficits of Crops Research Scientists in Major Crop Improvement Programs in Kenya, Early 1980s.

Rank	Breeding	Agronomy	Pathology	Entomology
1	Grain Legumes	Horticulture	Rice	Grain Legumes
2	Roots and Tubers	Maize	Horticulture	Rice
3	Horticulture	Sugar	Sugar	Sugar
4	Sugar	Rice	Maize	Cotton
5	Rice	Wheat/Barley/Triticale	Pyrethrum	Maize
6	Sorghum/Millet	Roots and Tubers	Roots and Tubers	0 Pyrethrum 0
7	Oil Seeds	Oil Seeds	Cotton	Sorghum/Millet
8	Maize	Pyrethrum	0 Oil Seeds 0	Oil Seeds
9	Cotton	Cotton	Grain Legumes	Roots and Tubers
0 0				Horticulture
10	Pyrethrum	Grain Legumes	Sorghum/Millet	Wheat/Barley/Triticale
11	Wheat/Barley/Triticale	Sorghum/Millet	Wheat/Barley/Triticale	
		0 0		

Source: Derived from Kenya Agricultural Research Institute, Organization of The Kenya Agricultural Research Institute and ISNAR/NCST 1982 Manpower Survey. Crops below the 0-0 line are considered adequately served currently in the discipline indicated.

Table 21. Crops Scientist Requirements Submitted by Research Station Directors, 1981.

Station	In Post 1980/81	Time Period	Additional Requirements	Total Requirements
Kitale NARS	18[2]	not specified	-	48[1]
Nyanza ARS.	5	"	5	10
Thika NARS	25	"	15[1]	n.a.
NAL Pathology irrigation		"	3[1]	n.a.
Soil + Agric. Chemistry		"	8[1]	n.a.
Kibos, NSRS	2[1]	"	8[1]	n.a.
Kibos, CRS		"	-	n.a.
Mwea-Tebere ARS	10[3]	(1982-1992)	-	71[3]
Embu ARS	2	not specified	5	7
Katumani, NDLRS	15	"	33	48
Lanet NSQCS		"	-	11

Notes
1. At M.Sc. level and above; 2. Includes seven officers undertaking M.Sc. courses; 3. National requirements for cotton, oil crops, and rice.

Source: Submissions to 1981 ISNAR Mission.

Forestry Research

The KARI forestry research scientist requirements are presented in Table 22. It is estimated that 51 experienced scientists are needed to undertake research in the areas enumerated, namely, tree improvement and afforestation, 11; water management and forest environment, 8; forest protection, 16; forest products, 10; economics and marketing, 5; and genetic resource conservation, 1. The overall KARI estimate is similar to forestry research manpower requirements for the five research stations at Muguga, Turbo, Mombasa, Hola, and Kibwezi submitted by the Ministry of Environment and Natural Resources (MENR) to an IBRD mission evaluating the Fifth Education Credit in 1980. Hence future requirements for forestry research scientists are approximately three times larger than 1982 employment levels.

Manpower requirements for forestry research for 1982 to 1993 were also submitted to us by the Director of Forestry Research. These include provisions for extra stations and are presented in Table 23, where it can be observed that the desired stocks of experienced and inexperienced forest scientists total 92 in 1988 and 200 in 1993, which are approximately 80% and 400% higher than the 1980 KARI estimate and approximately 5 and 11 times greater than the stock of forestry research scientists in 1982

Animal Production

Total requirements of animal production research scientists outlined in the KARI report are presented in Table 24. Out of a total of 65 Kenyan scientists engaged in animal production and range management research in Kenya in mid-1982, only 23 are known to have more than six years experience, although approximately 32 have or are presently acquiring postgraduate qualifications. This once again highlights the urgent need to improve the experience profile of the cadre of agricultural research scientists in Kenya in addition to increasing the numbers of scientists in the system as a whole.

The Deputy Director (Research) in the Ministry of Livestock Development also submitted a memorandum on postgraduate training requirements for animal production research stations for 1983 to 1988. From Table 25 it can be seen that a total of 120 scientists are considered to need postgraduate training during the next five years. Assuming that the 30 or so animal production scientists with only B.Sc. qualifications who are currently employed are sponsored on postgraduate courses, this implies that the Research Division would like to recruit another 90 graduates in the next four to five years. Taking into account an attrition rate of 6% per annum, this would result in a net increase of approximately 60 scientists by 1988, just over 90% of the 1982 level of employment.

Animal Disease

The KARI estimates for experienced veterinary research scientists are presented in Table 26. We only traced 6 Kenyan veterinary scientists who were known to have more than six years experience out of a total of 98 scientists employed at the Veterinary Research Laboratories (VRL) (under the Ministry of Livestock Development) and the Veterinary Research Department within KARI. Hence at least a five-fold increase in

Table 22. KARI Estimate of National Requirements of Forestry Research Scientists.

Tree Improvement and Afforestation	Scientists
Tree Breeders	3
Silviculturists	6
Agro-forestry	2
Water Management and Forest Environment	
Forest Ecologists	4
Watershed Management Scientists	2
Soil Scientists	2
Forest Protection	
Forest Entomologists	6
Forest Zoologists	2
Fire Control Specialists	3
Forest Pathologists	5
Forest Products	
Wood Engineers	3
Wood Chemists	2
Wood Anatomists	2
Wood Utilizations Technologists	3
Economics and Marketing	
Forest Mensurationists	3
Forest Economists	2
Genetic Resource Conservation	
Forest Tree Geneticists	1
Total	51

Source: Kenya Agricultural Research Institute, Organization of The Kenya Agricultural Research Institute.

experienced veterinary scientists is required to satisfy the KARI national requirement estimate of 40.

In its submission to the ISNAR/NCST mission, the Research Division of the Ministry of Livestock Development stated that it requires approximately 20 M.Sc./Ph.D. places per year in order to fulfill its manpower development program for veterinary scientists. Given that 35 to 40 veterinary research scientists at VRL have still to receive postgraduate

Table 23. National Requirements for Forestry Research Scientists, 1982 to 1993. Submitted by Director of Forestry Research.[1]

	Principal Research Officer			Senior Research Officer			Research Officer			Assistant Research Officer			Totals		
	82	88	93	82	88	93	82	88	93	82	88	93	82	88	93
Mgt. Plant. Forests	-	1	2	1	2	3	-	2	4	-	2	4	1	7	13
For. Genetics + Imp.	-	1	2	1	2	2	1	2	3	-	2	4	2	7	11
Mgt. Nat. Forests	-	-	1	-	1	2	1	2	4	-	2	4	1	5	11
Dryland Afforestation	-	1	2	-	2	4	1	2	4	2	4	6	3	9	16
Community Foresry	-	-	1	-	1	2	1	2	3	-	2	4	1	5	10
Forest Mens. + Econ.	-	-	2	-	2	4	1	2	4	-	2	4	1	6	14
Forest Products	-	1	2	1	2	4	2	3	6	-	2	6	3	8	18
For. Ento + Zool.	-	1	1	1	2	4	-	3	4	1	2	6	2	8	15
For. Path.	-	1	1	1	1	2	-	2	3	1	2	3	2	6	9
For. Fire Res.	-	-	-	-	-	2	-	1	2	-	2	3	-	3	7
Tree Seeds Res.	-	-	1	-	1	2	-	2	3	1	2	4	1	5	10
Coast For. Res. Stat. (FRS)	-	-	-	-	-	2	-	1	3	-	2	4	-	3	9
Kibwesi FRS	-	-	-	-	-	2	-	1	3	-	2	4	-	3	9
Londiani FRS	-	-	-	-	-	2	-	1	3	-	2	4	-	3	9
Isiolo FRS	-	-	-	-	-	2	-	1	3	-	2	4	-	3	9
Marsabit FRS	-	-	-	-	-	2	-	1	3	-	2	4	-	3	9
Ramogi FRS	-	-	-	-	-	2	-	1	3	-	2	4	-	3	9
Turkana FRS	-	-	-	-	-	2	-	1	3	-	2	4	-	3	9
Totals	1	7	16	5	17	47	7	30	61	5	38	76	18	92	200

Note: (1) Excludes 1 director and 2 assistant directors.

Source: Computed from data submitted by Dr. J. Odera, Director of Forestry Research.

Table 24. KARI National Requirements for Animal Production Research Scientists in Kenya.

Field of Research	Specialization	Number of Scientists
Calf Rearing	Ruminant nutrition and physiology with knowledge of beef and dairy cattle management	4
Reproductive Physiology	Animal physiology with emphasis on reproductive disorders and artificial insemination	3
Beef Production	Ruminant nutrition with knowledge of beef cattle management and by-product utilization; carcass analysis and meat quality.	8
Forage Production	Ruminant nutrition with emphasis on dairy animals by-product and residue utilization	8
Small Ruminant Production	Ruminant nutrition with expertise in sheep and goats; breeding and genetics	4
Poultry Production	Poultry nutrition and genetics; by-product utilization	3
Pig Production	Nutrition and genetics. Knowledge of by-product utilization	2
Range Management and Wildlife	Range ecology, general botany and zoology, plant physiology, climatology	5
Animal Traction	General animal physiology with knowledge of genetics	2
Camels	Breeding and genetics. Nutrition and general physiology; reproductive physiology	2
Total		41

Source: KARI, op. cit.

Table 25. Postgraduate Training Requirements for Animal Production and Related Research Scientists, 1983 to 1987.

Subject	Qualifications Required: Number/Year	Duration	Total 1983-88
Animal Production (breeding, nutrition, etc.)	5 M.Sc./Ph.D., increasing to 15 after 5 years*	5 years	25
Animal Feed (forage, pasture)	10 M.Sc./Ph.D.	5 years	50
Range Science	5 M.Sc./Ph.D.	not specified	25
Agricultural Economics	3 M.Sc./Ph.D.	5 years	15
Rural Sociology	1 M.Sc./Ph.D.	5 years	5
			120

Notes: (*) In anticipation of projected B.Sc. animal production output.

Source: Submission to second ISNAR/NCST Mission, June 1982.

training, and assuming an attrition rate of 6%, this implies that the Research Division would like a net increase of approximately 25 veterinary research scientists during 1983 to 1987.

Overall Requirements for Research Scientists

Research scientist requirements for crops, forestry, animal production, and veterinary research in Kenya are summarized in Table 27. The attainment of the manpower requirement estimates of the station directors in the crops sector and those submitted by directors of research for forestry and animal diseases and production would require nearly a doubling of the present stock of Kenyan agricultural scientists during the next five years. If it is assumed that the agricultural research budget would also have to be doubled in order to finance this increase in research scientists, this implies an annual average rate of growth of expenditure in constant prices of approximately 15%. The likely feasibility of such an increase will be considered in the following chapter.

Table 26. KARI Estimates of National Requirements for Experienced Veterinary Research Scientists.

Disease/Discipline		Number of Scientists
Bacterial Diseases		
	Brucellosis	2
	Contagious Caprine Pleuropneumonia	2
	Contagious Bovine Pleuropneumonia	2
Protozoal Diseases		
	Theileriosis (East Coast Fever)	
	Pathology	5
	Biochemistry	2
	Immunology	4
	Chemotherapy	2
	Epidemiology	2
	Tick biology and control	3
Viral Diseases		
	Malignant Catarrhal Fever	
	Epizootiology	1
	Immunology	1
	Virology and vaccine development	1
	Rinderpest	
	Tissue culture and vaccine production	1
	African Swine Fever	
	Epizootiology and Immunology	3
	Infectious Bovine Rhinotracheitis	
	Virology	2
	Nairobi Sheep Disease	
	Virology	1
	Parasitic Diseases	
	Bovine Cysticercosis	2
	Fascioliasis	2
	Wildlife Diseases	2
		40

Source: KARI, op. cit.

Table 27. Total Requirements for Agricultural Research Scientists, 1983 to 1987.

Area of Research	Total Requirements: For Exp. Scientists KARI Estimates	Total Requirements: Research/Station Director Estimates
Crops	272	440 - 660
Forestry	51	90
Animal Production	49	130
Veterinary	40	125
	412	785 - 1005

Sources: KARI, op. cit. and submissions to second ISNAR/NCST mission, June 1982.

CHAPTER 5

CONSTRAINED DEMAND FOR AGRICULTURAL RESEARCH SCIENTISTS, 1983 TO 1987

Target Expenditures for Agricultural Research

The unconstrained employer demands for agricultural research scientists must now be evaluated in relation to the likely ability of the Government of Kenya to finance these increases in high level scientific manpower. It is necessary therefore, to estimate the size of the agricultural research budget in Kenya over the next 5 to 10 years. Agriculture is the major industry in Kenya, and the national agricultural research service provides the industrial research support for that industry. The level of support should relate to the level of activity of the agricultural industry as a whole. A convenient measure of this activity is the agricultural Gross Domestic Product (although a great deal of the service and commercial sectors also depend on the basic agriculture industry). There is an emerging consensus that countries should invest at least 1% of their agricultural GDP on agricultural research, and the World Bank has recommended that developing countries should steadily increase their allocation to 2%, in view of agriculture's dominant position. We believe this figure is overly ambitious as an immediate target since, as Oram points out, "it surpasses rates of investment in research in nearly all high income countries." However, it is a target to move towards over a longer period.

Kenya already spent nearly 1.1% of its agricultural GDP on agricultural research in 1979, and it is apparent from the analysis of unconstrained demands for additional manpower that there are still strong pressures for the continued expansion of the research system during the 1980s. While it is not within the terms of reference of this report to make detailed recommendations concerning the optimum size of the agricultural research system in Kenya, we were impressed by the argument presented to us that a sizeable proportion of the activities of agricultural research stations (perhaps as much as 30% on average) relate primarily to service functions and that within the budgeting system less than 1% of agricultural GDP is being spent on agricultural research. The nominal figure should therefore be raised to ensure an appropriate proportion of the funds is applied. Furthermore, it is widely recognized that there is an urgent need for significant advances in improved agricultural technology in Kenya if the high rates of growth presented in the 1981 Food Policy Paper are to be attained. In expectation that due weight will be given to these reasons, we have based our manpower projections on a 1.5% target of agricultural GDP for the agricultural research system.

Assuming this firm and logical basis in the agricultural GDP, it follows that the increase in resources available to the agricultural research system during the next 5 to 10 years will be dependent upon the rate of growth of the agricultural sector as a whole. In Table 28 the projected sizes of agricultural GDP in 1987 and 1993 have been calculated using three possible average annual rates of real growth of agricultural output. The rapid growth of the agricultural sector in Kenya has been rightly acclaimed as being one of the major achievements of the development process since independence. However, as pointed out in the 1981 Food Policy Paper, the average rate of agricultural growth per annum from the early 1960s up until the late 1970s did not exceed 3.5%. In spite of the serious problems that have been experienced during the last three to four years in sustaining the same momentum in the growth of

agricultural output, recent important policy changes coupled with more favorable climatic conditions would appear to be already resulting in a renewed expansion of the agricultural sector. We will assume, therefore, that the average annual rate of growth of agricultural output will be 4% during 1983 to 1993. This gives an expected agricultural GDP of K£1125 million in 1993. At 1.5% of this, the projected expenditure on agricultural research in 1992 is K£16.87 million (US$30.8 million), which is an increase of K£9.00 million (114%) over the 1981 expenditure on agricultural research of K£7.87 million (US$14.4 million) at constant 1980 prices.

Table 28. Projected Size of Agricultural GDP (K£ Million) in 1987 and 1993 (at Constant 1980 Prices).

	Average Annual Growth Rates		
	At 2%	At 4%	At 6%
Agric. GDP 1981	730.8	730.8	730.8
Projected Agric. GDP 1987	823.0	924.7	1036.6
Projected Agric. GDP 1993	908.6	1125.0	1387.3

Source: 1981 Annual Statistical Abstract; and 1982 Budget Statement.

Projected Net Increases in The Number of Agricultural Research Scientists

The next stage in the analysis is to calculate the percentage of the present agricultural research budget which is allocated to research scientist emoluments. The provision for research scientists comes under several budget heads that include research and development, as shown in Table 29. The proportion that goes to scientist emoluments under each head varies considerably, but in the aggregate 15% of the total allocation to research and development is for remuneration of research scientists. We use this figure for the purpose of planning future numbers of research officers, but it should be noted that for the largest allocation, for crops research, the proportion is 23% and the calculations assume reasonable constancy in the balance of allocations under the different heads.

Furthermore, this figure for scientific research staff does not include the salary costs of support personnel (which will be considered in more detail in Chapter 6). The proportion of the total agricultural research budget allocated to personal emoluments has risen considerably in recent years, with the result that essential expenditure on research supplies, equipment, transport, etc. has been seriously "squeezed," to the extent that the research performance of the scientific and support staff has been jeopardized. The proportion of resources for operation and maintenance of research should not be reduced further (indeed it should be increased). We recommend, therefore, that research scientist emoluments should not be allowed to increase above the present level of 15% of total expenditure. Hence we will assume that 15% of the projected increase in agricultural research expenditure can be allocated to research scientist emoluments. On the basis of the present civil service salary scales, we estimate that approximately K£400,000 (25.7% of total 1982 research scientist emoluments) must be deducted from the additional K£1,350,075 available for research scientist emoluments in 1983 to 1993 in order to pay for the salary increases of scientists already in post. This can be termed the

increment/job grade inflation factor. The remaining K£950,075 can be used to finance net additions to the stock of research scientists.

Finally, we have assumed that the present civil service salary scales will remain constant in 1980 prices and that the average salary for an agricultural research scientist will be K£2500 (US$4575) throughout 1983 to 1993. Table 30 sets out the net increases in agricultural research scientists that can be expected on the basis of the foregoing analysis, with the asumptions that 1.5% of agricultural GDP will be allocated to research and development, and that the agricultural output will increase at 4% per annum. This will allow an additional 380 agricultural research scientists to be employed in the agricultural research system during the next 10 years (i.e., 38 per year). This is about half the number of additional scientists estimated to be required on the basis of unconstrained demand estimates from station directors, but does not diverge significantly from the implied (experienced plus inexperienced) KARI scientist requirements.

It must be pointed out however that changing the assumptions underlying this constrained demand analysis has a dramatic effect on the net additions of agricultural research scientists that can be absorbed. This can be clearly observed in Table 30 where the above calculations have been repeated using more pessimistic assumptions of no change in the current percentage of agricultural GDP allocated to agricultural research (i.e., 1.1%) and/or only 2% average annual real growth of agricultural GDP from 1983 to 1992. If both pessimistic projections proved realistic, and the same analysis was applied, it would suggest cutting back the number of research staff.

Table 29. Total Research Scientist Emoluments as Percentages of Combined Recurrent and Development Expenditures on Agricultural Research, 1982 to 1983.

Ministry	Code	Research Area	Total Scientist Remuneration (K£)	Total Expenditure (K£)	as % of Expenditure
MOA	230	Scientific Res. Division	71,591	147,761	48.4
	231	ASARC	6,614	13,020	50.7
	232	Crop Research	863,416	3,758,746	23.0
MOLD	277	Vet. Lab & Research	197,675	1,497,193	13.2
	284	Range Research	88,663	1,018,153	8.7
	294	Animal Husbandry	166,796	1,627,948	10.2
MPDST	246	ARD	158,159	2,374,740	6.6
			1,552,914	10,437,561	14.9

Source: 1982/83 Recurrent and Development Estimates of Expenditure.

Table 30. Net Increase in Agricultural Research Scientists, 1983 to 1992.[1]

	ASSUMPTIONS			
	1.5% ag. GDP; 4% ag. growth	1.5% ag. GDP 2% ag. growth	1.1% ag. GDP 4% ag. growth	1.1% ag. GDP 2% ag. growth
Increase in agricultural research budget 1982 to 1992	9,005,000	5,760,000	4,505,000	2,124,600
Additional expenditure available for R.O.[2] emoluments of which:	1,350,075	863,850	675,750	318,690
Amount required for higher emoluments of existing R.O. staff via "grade inflation"	400,000	400,000	400,000	400,000
Remainder available to finance new R.O. recruits	950,075	463,850	275,750	-81,310
Net increase in the stock of R.O.s 1982 to 1993	380	190	110	-33
Average annual net increase in stock of R.O.s 1983 to 1992	38	19	11	-3

1 All expenditure figures are expressed in Kenyan pounds.

2 R.O. = Research Officer, the official designation of most agricultural research scientists in Kenya.

Budgetary Implications

The projected increase in the agricultural research budget from K£7.78 million in 1981 to K£16.87 million in 1993 will require an average annual rate of expenditure growth of over 7.5%. While this is relatively modest compared with the high rates of growth in expenditure achieved in the 1970s, budgetary constraints will almost certainly be more stringent during the remainder of the 1980s. The government is currently attempting to curtail the very large increases in public sector borrowing of the last few years. A longer term objective is to reduce government expenditure from 35% to 30% of national GDP. The total combined recurrent and development forward budget between 1981/82 and 1984/85 is planned to increase at 4.3% per annum compared with the 7% to 8% annual rates of growth which were experienced during the 1970s. However, it can be seen from Table 31 that overall planned expenditures for the Ministries of Agricultural and Livestock Development during the next three years are 6.4% and 6.9%, respectively. If, therefore, these rates of growth can be maintained during 1983 to 1992, it seems likely that the constrained demand projections for agricultural research scientists are realizable from a budgetary point of view.

The Allocation of Additional Research Scientists from 1983 to 1987: Research Priorities

The unconstrained demands for agricultural research scientists range between 80 and 180 per year, assumed over 5 years (Table 27). Since these are far in excess of the projected constrained net increase of 38 per year between 1983 and 1987, it is necessary to decide how the additional manpower should be allocated over the major areas of research. The future allocation will depend on a set of objectives and priorities for research to facilitate the implementation of the national development plan for the 1980s; but as yet these priorities have not been formulated nationally in sufficient detail to provide firm plans. It is not within the terms of reference of this report to make recommendations concerning the detailed national research objectives. However, it is necessary to have some plan in order to illustrate the formulation of manpower and training strategies for agricultural research manpower in Kenya which will be presented in Chapter 8 through 11.

Accordingly, a tentative set of priorities are drawn up as a basis for discussion of the planning methodology. While the arguments put forward are based firmly in conceptions contained in the National Development Plans and on discussions held with Ministry officials both in the present mission and the previous ISNAR mission, the definitive set of research priorities and objectives will, of course, be drawn up by senior national staff after national consensus has been reached.

Aspects of the history of agricultural research and agricultural development in Kenya were briefly described in the ISNAR/NCST Report on Kenya's National Agricultural Research System, and the implications of changes in the pattern of agriculture for the research program were outlined. In the National Development Plan, it has been pointed out how agricultural development emphases must change. The high potential areas which were farmed in large units must be managed more intensively in small-scale systems. Extensive grazing in these areas must give way to more intensive stall feeding. Above all, under the increasing pressure of population increased production of crops, livestock, and trees (for fuel and fodder) must be obtained from more marginal areas.

Table 31. Development and Recurrent Forward Budgets 1981/82 to 1984/85 (K£ Million).

Ministry		Gross Estimates 1981/82	Forward Budget Ceilings 1982/83	1983/84	1984/85	Total	Compound Growth Rate
	Recurrent	24,975	26,700	28,600	31.100	86,400	7.6
Agriculture	Development	31,832	33,500	35,100	37,400	106,000	11.5
	Total	56,807	60,200	63,700	68,500	192,400	6.4
% increase		---	7.3	5.8	7.5	---	---
	Recurrent	11,743	12,600	13,400	14,700	40,700	7.8
Livestock	Development	10,139	10,700	11,300	12,000	34,000	3.7
	Total	21,882	23,300	24,700	26,700	74,700	6.9
% increase		---	6.5	6.0	8.1	---	---
	Recurrent	545,787	570,000	593,000	620,000	1,783,000	4.3
All	Development	281,843	296,000	307,000	318,000	921,000	4.2
	Total	827,630	866,000	900,000	938,000	2,704,000	4.3
% increase		---	4.7	3.9	4.2	---	---

Source: Computed from unpublished data, The Treasury (Ministry of Finance).

Earlier there was a great deal of temperate agriculture, large-farm technology which could be exploited with little adaptation by local research. The current situation calls for more vigorous research to modify and adapt temperate and subtropical technologies for small-farmer intensive systems in the high potential areas, and to develop suitable materials and methods for utilizing the lower potential areas. The research task is much greater than it was in earlier years.

Changes will be necessary in the research system, some of which will take time. For instance, the initial establishement of research stations was geared to serve the high potential areas which were settled by the expatriate community. Research by Jamieson shows that in spite of the strong development of the smallholder sector during the post-independence period, the orientation of the agricultural research system has been slow to change. Table 32 shows that the agricultural research scientists continued to be heavily settled in the Central and Rift Valley Provinces. A disproportionate amount of resources continuedto be channelled into crop programs at the national research stations. Only 18.45% and 4.04% of Kenyan and foreign scientist "education years"* were allocated to

Table 32. Location of Agricultural Research Scientists by Province, in percentages 1963 to 1978.

	Nyanza	West	Rift Valley	Central	Eastern	Coast
1963	1.09	1.83	13.52	78.17	4.23	0.56
1968	1.42	0.00	15.88	77.25	2.50	2.95
1973	5.11	0.52	27.74	61.00	2.92	2.71
1978	5.64	0.56	25.10	59.00	3.77	5.92

Source: B. M. Jamieson, op. cit.

regional research stations. And, out of a total of 329 project years of agricultural research supported by external donors between 1963 and 1978, only 30 (9.1%) were committed to animal production research.

There has been a growing realization among senior research planners since the late 1970s of the serious mismatch between the implied priorities in the current allocation of resources for agricultural research and the long-term research program that is needed in order to support the Government of Kenya's overall development policies for the agricultural sector. For example, Wang'ati, on the basis of a preliminary analysis of the pattern of resource allocation among major crops, concludes that

*Jamieson weights the formal qualifications of research scientists as follows: Ph.D. = 3, M.Sc. = 2, B.Sc. = 1.

"generally, the quantity and quality of scientific staff seem to bear little relationship to the relative importance of commodities." With regard to animal production, the Committee on Maize and Pasture noted that "we did not find a comprehensive and integrated national research strategy for animal production in existence." These research activities have lacked a stable base since they had been "sandwiched" between crop and veterinary research, and have been aimed primarily at larger farmers.

Deliberate choices have to be made to direct the balance of research effort to the new areas of priority, especially as far as newly recruited staff are concerned. Following discussions with senior personnel from the Research Division of the Ministries of Agriculture and Livestock Development, KARI, and NCST, we sought to formulate a consensus view of agricultural research priorities for the next five years. We recommend, as a basis for discussion of recruitment and training plans, that more emphasis be given to the following areas:

- animal production research;
- forestry research (many developing countries allocate relatively more of their research scientists to forestry research than does Kenya according to the review by Oram and Bindlish);
- food crop research; in particular on maize, sorghum, millet and rice, grain legumes, root crops, and vegetables;
- research in drier areas of the country, sub-humid to arid;
- development of regional research stations - in particular at the coast and in the west of Kenya - capable of undertaking effective applied and adaptive research geared to the needs of small farmers in the surrounding areas;
- interdisciplinary research on farming systems and the socio-economic implications of advances in scientific knowledge and technology on "farmer circumstances";
- improvement of linkages between extension and research.

It is not possible or appropriate to enter into a long discussion of the detailed reasons for assigning such priorities: some elements will be discussed further in Chapters 8 through 11 in connection with training requirements. There is broad agreement on the thrust of emphases on commodity and regional research. However, there is not yet full agreement and appreciation about the importance of on-farm adaptive research in Kenya, and this merits some special mention here.

The initial ISNAR/NCST Report to the Government of Kenya reviewed the integrated and cyclical nature of a national agricultural research system designed to serve the development process. An essential element in this process is the need to check that recommended technologies really do improve the farmer's well being and help in achieving his objectives as well as those of the government. Modifications to the technologies may prove necessary. This final stage of adaptive research on the farmers' field, is usually done in developed countries by the large farmer himself

or by private suppliers of inputs of seed, machinery, chemicals, etc. In developing countries, in the absence of such private resources, these essential stages of research must be carried out by the public research and extension services together with the farmers, but this need has often not been recognized when models of public research systems originating in developed countries have been transfered and used elsewhere.

Because of the emphasis now being placed on developing technology for small farmers in intensive systems, there is an urgent need to readjust the balance of effort to increase the emphasis on on-farm adaptive research.

Allocation of New Scientists

The analysis of demand for scientific research manpower, under the constraint of realistic expectation of allocations of funds, suggested a net rate of increase of 38 scientists per year from 1983 to 1987. On the basis of the above research priorities and much detailed discussion, we recommend that the net new positions should be allocated broadly as follows: crop research, 15 per year; animal production research, 11 per year; veterinary research, 2 per year; and forestry, 10 per year. Additional recruitment will be necessary to compensate for attrition of scientists. The average rate of annual recruitment during this period as illustrated in Table 33, must therefore be approximately 40 graduates for crops research, 16 for animal production, 8 for veterinary, and 12 for forestry research.

Table 33. Recommended Net Annual Increases and Recruitment of Agricultural Research Scientists by Major Research Activity in Kenya, 1983 to 1987.

Area of Research	Current Stocks 1982	Net Increase in stock per year	Av.replacement for attrition	Projected Stock 1987	Total recruitment per year
Crops	385	15	25	460	40
Animal Prod.	65	11	5	120	16
Veterinary	98	2	6	108	8
Forestry	18	10	2	68	12
Totals	566	38	38	756	76

Comparison with the Present Pattern of Graduate Recruitment to Agricultural Research

Recent rates of recruitment of graduate staff for agricultural research have been a little higher overall than that indicated above. From the data collected in our 1982 manpower survey, the average annual rates of recruitment between 1979 and 1981 were: for crops research, 59; for animal production, 7; for veterinary research, 16; and for forestry, 2. Adoption of the distribution proposed in Table 33 would therefore imply a reduction of about 30% in crops research recruits and halving recruitment into veterinary research, while doubling the recruitment to animal production research and achieving a six-fold increase for forestry research. Clearly such large changes could not be achieved immediately, but would constitute urgent targets.

The overall requirement to strengthen regional research stations and the capacity for adaptive and on-farm research implies that a substantial proportion of the recruits should have a broad grounding in agricultural science, either at the first-degree level or during postgraduate training.

In order to ensure that recruitment targets are attained, it is essential that the annual recruitment of graduates be carefully monitored by a central coordinating body with sufficient authority to ensure that ministries do not deviate significantly from the manpower development plan. It is for this reason that we support the present move to channel the recruitment of B.Sc. (science) graduates through the Public Service Commission.

CHAPTER 6

RECRUITMENT, CAREERS, AND PERSONNEL COSTS

The discussion so far has tended to be about resources and numbers of scientists required to carry out research towards improving agricultural development and increasing farmers' incomes. However, scientists are equally concerned about earning reasonable incomes and working in circumstances conducive to achievement. Moreover, scientists are only part of the research service. Technical support and clerical staff are also essential, and they too require stable and satisfying career opportunities to encourage loyalty and long-term service.

The management of human resources in agricultural research has two parts: getting appropriate people into research organizations, and creating conditions of service which will motivate them to work diligently towards the objectives of the organization.

The two processes should ideally be linked. The qualification at recruitment should reflect the initial requirement for the full pattern of development up to "career expectancy" within the cadre to which the recruit is appointed. However, no system is perfect in allocating staff to appropriate cadres right from the time of recruitment, and some flexibility of movement, essentially upwards, is necessary to satisfy the aspirations and competencies of deserving workers, and so to avoid the inefficiencies arising from frustrations.

We anticipate that the senior agricultural research personnel would be in three basic cadres (job categories) with relatively distinctive responsibilities: research managers, researchers, and technicians (backed by junior technical assistants). Persons in each category should be able to rise to high levels of expertise in his own field and be rewarded accordingly without having to change cadres. Although it is always highly probable that a senior manager will have a better reward than a senior researcher or a senior technician, there should be a considerable amount of overlap with salary scales to allow for a satisfying career in each cadre. The positions are not usually interchangable: a good research manager would often make a poor researcher or technician without extensive retraining, and vice versa.

Academic <u>qualifications</u> at the time of recruitment are often used as indicators of potential suitability to particular cadres, but these should be regarded as such, and not as sacrosanct barriers to movement between cadres in the course of service. The <u>grades</u> into which recruits are placed on appointment to a cadre carry different salary scales. A degree of confusion seems to exist about the interrelationship between cadre, qualification, grade, and salary scale.

It was frequently reported to us that the barriers erected at the time of recruitment are indeed very high, that initial qualification tends to condemn a recruit to a higher or lower class of citizen in the service, and that the overlap in salary scales was not attractive enough to retain expert technicians. We recommend that a high degree of flexibility in grading within cadre structure be maintained so that good research staff in all cadres can be retained in positions where they are especially

effective, rather than lost to the service or transferred to other positions where their special expertise is less useful.

Recruitment

Recruitment in Kenya at the stage of initial qualifications is only into two cadres, technicians and researchers. (Recruitment or promotion to research manager comes at a later stage, often after response to advertized vacancies, and usually without any special training for management.) Appointments are made to three recruitment grades depending on qualifications as indicators of potential suitability.

Qualification	Recruitment Title	Recruitment Grade
Diploma	Technical Officer	G
BSc (science)	AAO II	H
BSc (agri)	AAO I	J

Both Assistant Agricultural Officers I and II are in the researcher cadre, and graduate recruits to research are expected to have achieved at least upper second class honors in these degrees so that they are qualified for postgraduate study at Nairobi University.

The rationale behind such gradings is clear. The university requires a higher entrance qualification than the college and gives a more rigorous three-year course in agricultural and other sciences. The diploma course is also three years and has a more practical emphasis which would be expected to be a more suitable basis for the responsible role of support technician in the research service. The Ministry of Agriculture is a technical department and prefers recruits to be trained in the specific subject with which it deals rather than in more general science. Succesful postgraduate study in agricultural science can convert an Assistant Agricultural Officer II to Assistant Agricultural Officer I.

However, at present the distinctions between the qualifications may not be as clear-cut as the rationale assumes. For example, we were told several times that most Egerton College students actually enter their diploma course with one or two "A"-level passes, well above the minimum "O"-level credits required. While such passes are undoubtedly lower than those of students entering the agriculture degree course at the university, they are perhaps not sufficiently lower to justify the much less attractive careers currently open to diploma-holders as technicians in the research service. Moreover, as many secondary schools came into operation relatively recently, it is not possible to guarantee equality in teaching standards, and therefore the achievement in "A"-level exams might not be as reliable a reflection of an individual's potential as the division between university and college might presume.

In this rapidly changing environment for recruitment, there are perhaps dangers in having a rigid system that links qualification and grades so strongly, and that results in potentially good agricultural research officer material being lost to the service.

Despite the Ministry of Agriculture's apparent preference to recruit graduates in agriculture (and the great need to increase the numbers of such recruits for more effort in the high priority areas of farming

systems and adaptive research), we learned that an increasing number of recruits to agricultural research are graduates in general sciences: in 1981 recruits in to the Ministry of Agriculture with B.Sc. (science) outnumbered those with B.Sc. (agriculture) by 4:1. It was also reported that this was leading to many early resignations as the conditions of service and environment were not what such graduates expected. Rapid turnover and lack of stability is not conducive to effective research.

The government has recently taken a major step to deal with the problem. Under a revised recruitment procedure for B.Sc. (science) graduates, sponsored by the Directorate of Personnel Management, the Public Service Commission will have the dominant voice in assigning such candidates to specific ministries and public organizations. We wholeheartedly support this initiative.

Careers

However, recruitment and assignment is just the first step. We strongly believe that the essential issue for the future stability and continuity for agricultural research in Kenya is the structure and opportunities offered in the careers following recruitment.

A major difficulty that was presented to us on many occasions was the serious shortage of "support personnel" for research (e.g., field supervisors at stations, and technicians in laboratories). The reason, it was claimed, was simply that certificate-and diploma-holders see research as a stepping-stone to further training and/or to better jobs elsewhere. Their solutions were many. For example:

(1) recruit technical assistants from the ranks of school leavers (i.e., people who might have less chance to leave);

(2) recruit laboratory personnel from polytechnics; and/or

(3) create a new category called "scientific assistant," to be recruited from B.Sc. ranks.

But the team feels that such cures treat symptoms rather than causes. From whatever pool new recruits are drawn, and however they are designated, they will not stay in research unless they see good career prospects. Technical assistants will not remain technical assistants forever; technical officers will not remain technical officers, etc. unless the scheme of service offers a reasonably satisfying career within the cadre.

At present there appears to be a lag between (1) the quality of potential recruits coming into the market, and (2) the conditions of service being offered to them.

The long-term solution is to modify the schemes of service to catch up with the potential of the new technical recruits available, and to give them more attractive prospects consistent with the importance of their contribution to the efficient operation of the research system. Appropriate in-service training courses should be arranged to upgrade the technical staff in competence and expertise in their essential role within the technical support cadre of the research systems. The raising

of the current salary grade ceiling for the cadre is undoubtedly an important first step to give new hope to competent technicians. We strongly recommend such an evolution. Some of the initial work necessary to support development of such a proposal is now being done (for example, in the DPM-supported study on needs for Technical Officers in agricultural research, the analysis of potential roles for Senior Executive Officers in agricultural research, and the various country-wide inventories of agricultural research personnel). We strongly support such initiatives.

An alternative mode of advancement should be available for outstanding diplomates with good academic performance. We have mentioned earlier that the early division into college and university students is not sharp, and there is some good potential degree-level material in the diplomate group. A clear channel should be created so that suitable candidates could be sponsored for in-service further study at Nairobi University towards a B.Sc. (agriculture) We understand that consideration is now being given to the development of a "transfer program" between Egerton College and the university, under which diplomate entrants into the university would be able to earn a degree with only one or two years of additional study. We firmly endorse this development, but we would caution against this being a large program or a common occurence as far as the research service is concerned; it should be seen as a valuable adjustment against the inefficiencies and injustices of early selection, but not as a routine line of advancement. It is not the role of Egerton College to prepare candidates for the university, and the curriculum should pursue its own goals. Already it was reported that some Egerton students were being encouraged to see their diploma course as a stepping-stone towards a degree.

We suggest that an Egerton diplomate recruited as a Technical Officer might be eligible for further training (usually nondegree but occasionally degree) if his/her performance over a prescribed period met predetermined merit standards. During this "apprenticeship," the diplomates would be supervised by a senior scientist who would evaluate their suitability for such training and would work with them in drawing up a career plan. Neither training nor promotion would be automatic, however, and very few people would likely move up from the technical support cadre to the research cadre.

A similar procedure should operate for recruits into Agrcultural Assistance Officers with B.Sc. (science) or B.Sc. (agriculture) degrees except that as they are already in the researcher cadre, the in-service training would be aimed at improving their research capacity. Elsewhere we elaborate on the proposal that all researchers should be trained to at least the M.Sc. level for formal introduction to research methodology and some experience of depth of special study. The proposed sequence of training is set out in Chapter 7.

Again, the job description and a dynamic scheme of service should keep pace with the development of highly trained personnel. The normal scheme of service should soon include provision for recognition of research achievement equivalent to earning a Ph.D. as experienced scientists become more commonplace. For example, at present one senior executive decried the lack of motivation among M.Sc. students -- but attributed it to the perception that an individual had reached the end of his career in the Ministry of Agriculture when he had reached, job grade K. Another

said that he had no choice but to support training only up to the M.Sc. level (though he knew that a research program could not be based on M.Sc.s), since the job descriptions and conditions available to persons with higher qualifications were not attractive enough to hold them.

Finally, a staff structure for agricultural research must include a cadre of research managers. Frequently senior researchers drift into management as the only avenue of promotion, but with no special aptitude or training. We recommend that likely managers should be selected relatively early in their career and given specific in-service training in management methods, preferably in management of research, so that a cadre is built up with genuine expertise in the area of management.

Personnel Costs

The funds allocated for agricultural research fall partly in recurrent and partly in development expenditures. The latter is made up mainly from specific development projects and contains large amounts of capital expenditure for buildings and other major items essential for the development of new research programs, but which are not part of the continuing recurrent research expenditure. The bulk of the continuing core research program is supported by the allocation from recurrent expenditure.

The proportion of recurrent funds for personal emoluments (for both scientific and support personnel) has been rising steadily in recent years, as illustrated in Table 34, and is now at a level that endangers research productivity (it is not so easy to interpret combined R and D figures because of the large distorting element for capital expenditure).

Table 34. Personal Emoluments as a Percentage of Total Agricultural Research Expenditure.

	1978/79	1981/82	1982/83 (estimates)
Recurrent (R)	50%	70%	71%
Development (D)	18%	16%	15%
R & D	44%	54%	51%

Approximately 70% of the recurrent budget for agricultural research is now being spent on personal emoluments. Senior officials frequently expressed to the team their concern that this figure is too high and their fears that it can be expected to become even higher in the future. Three complementary pressures are conspiring to drive the figure up.

(1) "Grade inflation." More members of the research establishment are reaching higher salary grades. They are being recruited at higher levels (because of higher academic qualifications) and their promotions are becoming more automatic. The bulk of the staff is young: there are few retirements from the upper levels.

(2) Foreign training programs. Really a corollary of (1). Under present schemes of service, individuals who achieve higher qualifications are entitled to placement in higher salary grades on return.

(3) Foreign projects. Again, really a corollary of (1). Many individuals who work as "counterparts" on externally supported projects come to expect better conditions of service, with the result that pressures for grade inflation are increased.

If the rate of rise of personal emoluments is greater than that of the overall allocation of funds to recurrent expenditure the margin for the implementation of the research program can be severely "squeezed." The result can be that the opportunities for the skilled research staff to carry out useful reseach are seriously reduced.

To illustrate the situation, we calculated the balance of personnel costs to other charges in the future if a rise in personal emoluments was at 7.5% per annum while the recurrent budget grew only at 4% per annum (linked to growth in agricultural GDP). By 1993, on these assumptions, all recurrent expenditure would be for personal emoluments. On the same assumptions, but this time considering the combined recurrent and development budgets, 98% of the total would be for personnel by the year 2000.

Unfortunately we do not consider the assumptions to be entirely unrealistic. The rate of increase in personal emoluments in the recurrent budget over the past three years has been greater than 7.5% (nearer 12%), and from the 1981/82 to 1982/83 estimates, the rate of growth is projected at 5.6% in the recurrent budget and 7.8% in the combined R & D budget.

To retain a viable margin of funding for the implementation of the research program, the rate of rise of the total research budget relative to agricultural GDP may need to be increased so that the absolute allocation to research will exceed 1.5%.

Alternatively, agricultural authorities could consider how to hold down the relative rate of increase of personnel costs. This would not be easy, but one step would be to carefully avoid any automatic promotion to higher grades, ensuring that promotion comes only on the demonstration of proven performance and merit.

Another step could be the development of more precise job descriptions in all categories of agricultural research activity with the aim of having appropriate jobs carried out by the lowest paid competent staff. We strongly recommend that NCST, in conjunction with the Directorate of Personnel Management, take the lead in developing detailed job descriptions. Only with such descriptions can the proper mix of new recruits be identified -- and only with an agreed-upon mix can career planning of the type advocated here be attempted. The issues in making such job descriptions are not ones of manpower and training only, but rather of the entire organization and program of agricultural research in Kenya.

CHAPTER 7

AN OVERALL TRAINING STRATEGY FOR AGRICULTURAL RESEARCH SCIENTISTS

A national agricultural research service has a range of roles to play. In summary, it should be able

(i) to make available to the government information on which reliable agricultural development plans can be based;

(ii) to make available to the farmers through appropriate channels the detailed agronomic and economic information on which to plan production of crops, stock, and trees, based soundly on adaptive research at the farmers' level;

(iii) to develop and maintain a group of trained, competent scientists in appropriate disciplines in research positions, capable of interpreting national and international scientific advances for the benefit of national development.

A training strategy must clearly be concerned with the development of a broadly based group that is capable of keeping up to date with the latest in agricultural science; this implies training staff to a reasonable depth of specialization in an appropriate range of fields. But the training program must also ensure that a high level of competence is generated to carry out the necessary research program on production problems of high national priority.

Research priorities in relation to the National Development Plan were discussed in the first ISNAR/NCST study, which stressed in particular the need for concentration on the problems of intensification of farming in small farmer systems, and for generating improved technology for lower potential areas. In relation to existing capabilities this implied a great increase in the intensity of effort on applied and adaptive research, especially on-farm research, to ensure that improved technologies were beneficial to farmers in their own environments. This area of research had been relatively neglected and deserved much more concentrated attention. The training program should therefore reflect the need, over the short to medium term, to give more emphasis to the development of skills appropriate to carrying out applied and adaptive research aimed at small-farmer systems.

Emphasis was therefore placed on aspects of farming systems research during visits to research stations when the view of station directors and senior scientists were sought concerning the training needs of new research officers entering the system. The areas covered include:

- the attitudes of young research officers toward production agriculture, field research, and farmers, who are the primary clients of agricultural research;

- the ability of new graduates to identify important production problems in their area of work and their ability to conceptualize research experiments and trials to identify solutions to these problems;

the competence of research officers in terms of the research skills they need to carry out research experiments and trials and to function effectively in an applied/adaptive research program.

Research Attitudes

One serious problem identified is the attitude of new graduates toward field research. As one scientist put it, "they think that once they have their B.Sc. degree, they are professionals. Professionals sit in the office and have assistants and secretaries to do the work." It appears that many young graduates do not realize or are unwilling to accept the fact that a lot of agricultural research involves extensive field work, long hours during peak periods, and regular interaction with farmers to understand their problems. As another scientist put it, "it takes me two years to untrain a new graduate and then to retrain him with the skills and attitudes he needs to begin to function in our research program." He went on to say that Egerton graduates generally do not have this attitude problem. They are familiar with production agriculture and field work and, because they are not research officers, are more willing to learn and to work in the field.

Developing positive attitudes and commitment toward agricultural field research in order to find solutions to farmer production problems, is one of the most difficult training problems to solve. As will be discussed more fully in later chapters, this is partly due to: (1) Agriculture is often not the first choice of students entering the Faculty of Agriculture and (2) agricultural research has had to rely increasingly on general science graduates who, because of their lack of knowledge and appropriate training, are likely to be less enthusiastic about conducting field research and solving farmer problems. There are many other facets of agricultural research but the final testing must be at the farmers' level. Unless many research officers are interested, motivated, and concerned with designing and implementing an active research program to make an impact on the farmer, they will be of limited value as Kenya seeks to meet immediate and longer term food production requirements.

Theoretical and Practical Knowledge

There is widespread agreement that B.Sc. (agriculture) graduates are academically well prepared in the basic agricultural subjects. However, because the B.Sc. degree is entirely an academic program, many graduates are weak in their practical knowledge of production agriculture, particularly the farming systems of small farmers. Nor do they have any experience in conceptualizing a research problem, designing a research experiment, implementing the experiment, making observations, writing up the findings, and drawing appropriate conclusions.

B.Sc. (science) graduates also have good academic preparation in their respective areas of the science curriculum, but they are not prepared in agricultural subjects. Obviously, they lack knowledge of production agriculture and many practical skills.

Generally, young research officers are expected to work under the tutelage of senior research scientists as "professional apprentices" for

a couple of years until they begin developing more independent research programs of their own. Unfortunately, because of the high turnover of staff within the Kenyan agricultural research system, there are few senior scientists who are available to serve as good role models for new entrants into the system. Expatriate research scientists can help over the short run, but over the long term this must become the responsibility of experienced Kenyan research scientists.

Meanwhile senior colleagues can give at least an introduction to the nature of the research task and the problems to be faced. It is, however, unrealistic to expect much training in research methodology in this informal way considering the large numbers of trainees and the relatively short time scale. Once they have had the introduction to the job, it is essential that the new research officers undergo formal training in research methodology (which is not included in undergraduate courses). This is best done by professionals in the art of rapid teaching, in an M.Sc. course at a University, during which some greater depth of study can also be applied to a specific field. Normal qualification for a research officer career in these modern times should not be considered complete without formal training in research methodology.

Those that have the intellectual ability and have shown a good level of performance in their work should also be given the opportunity to pursue a Ph.D. degree in a relevant subject. The sequencing of formal research training, as well as the criteria to be used in selecting research officers for these educational opportunities will be discussed later.

Research and Production Skills

In contrast, many field and laboratory research techniques can be learned on the job in a research assignment, or are easily taught in short courses of four to six months such as those offered at international agricultural research centers (IARCs). In many types of applied/adaptive research, the experimental design can be standardized and routinized so that only the treatments and/or variables are changed. This is particularly true for some on-farm adaptive research trials in which location-specific technical recommendations are being fine-tuned. Conducting on-farm adaptive research trials is an excellent method for young research officers to learn essential research and production skills, and to begin to learn how to interpret observations and results, as well as to become familiar with farmer production problems and systems.

While Egerton College graduates are not formally qualified to be appointed as research officers, they appear to be prepared in terms of production skills to carry out on-farm trials. According to some people, with some research training, and if working under the guidance of an experienced research officer, an intellectually capable diploma graduate could function effectively in implementing on-farm research trials. The experienced research officer would plan the treatments, and interpret the conclusions from an analysis of the data.

In summary, B.Sc. (agriculture) and B.Sc. (science) graduates both need training in research and production skills before they can begin to function effectively in field-oriented agricultural research programs. In an active and functioning research program, they can learn many of these skills on the job. In the absence of an effective research program

or as a supplement to on-the-job training, young crops research officers can profit greatly from research short courses offered by IARCs. In many cases, well-trained and capable Egerton diplomates, (Technical Officers) could be useful in conducting on-farm research trials.

Prioritizing Training Needs

For the young research officer, developing a positive attitude toward a career in agricultural research, and an orientation toward the role of an agricultural researcher as one who develops solutions to farmer problems, is probably the most difficult educational objective. However, unless a research officer is motivated and committed to actively pursuing a long-term career in agricultural research, it is not a good investment of scarce resources to send him for postgraduate training (especially abroad). First, he must demonstrate an interest and willingness to work in agricultural research.

Short courses at IARCs can be one excellent method of stimulating interest in agricultural research, as well as developing useful research skills and knowledge. Trainees participate in an active, functioning research program; they meet internationally known scientists at work in their research plots; and they sense the quiet enthusiasm toward agricultural research by scientists who have clear research objectives and who work hard to achieve them. The social milieu of an IARC is a good environment to begin fostering positive attitudes toward agricultural research.

IARC short courses are also particularly suited to teach relatively standardized research techniques, so that the returning research officer has a set of immediately useful skills. Also many returning trainees bring back new genetic materials and ideas that serve as catalysts to the national program, particularly when other officers have been on similar training courses. There are only likely to be a few places available at each IARC each year, and the courses are for groups; they are not geared to individual needs. Nevertheless, advantage should be taken whenever possible of their unique value for the early orientation to a research career.

Postgraduate education increases a research officer's knowledge of a particular field of study, provides formal training in research methodology and appropriate research techniques, and provides experience in each phase of the research process. Postgraduate training at the M.Sc. level should be considered the minimum qualification for all senior research officers, and Ph.D.-level training is necessary for selected officers. These will contribute to developing a cadre of senior scientists who can direct a comprehensive research program and provide research leadership for less experienced staff.

Sequencing Training Inputs

In analyzing the different training needs of young research officers and the types of degree and nondegree training opportunities available, it is recommended that a systematic staff development procedure be followed whenever possible, and that this be well publicized.

First we recommend that a research internship/familiarization program be introduced for the most capable students in the Faculty of Agriculture to

allow research directors to assess the quality of potential recruits to the agricultural research system while at the same time giving interested students the opportunity to obtain first-hand experience in agricultural research. Ideally this program should be run during the long vacation period, prior to the final year of the student's academic studies.

Second, once a research officer has been recruited, he/she should be on the job for at least one year before being selected for any type of training. The officer should be familiar with the objectives of the particular research program to which he or she is assigned and have gained some experience working in the program. During this year he/she should have demonstrated a willingness to learn, as well as a serious interest in the research program.

Third, if it is at all possible, young officers should be sent for an appropriate research short course at an IARC. As mentioned earlier, this will develop some enthusiasm for research, as well as provide research skills and techniques that can be used immediately upon return to the home research station.

Fourth, research officers should work for about two years before being sent for M.Sc. training, preferably at the University of Nairobi. Criteria for postgraduate study, in addition to being academically qualified, include having demonstrated a reasonable competence in research activity. The candidate should also have demonstrated interest in agricultural research. These criteria should be applied at an enhanced level in the case of foreign degree training. In the case of M.Sc. students at the University of Nairobi, every attempt should be made to tie thesis research to ongoing research assignments.

Merely having an M.Sc. degree, however, does not ensure that a research worker will be effective on the job. Particularly in applied and adaptive research, where the goal is to increase agricultural production and raise rural incomes, interdisciplinary research efforts are important. The focus and, in some cases, the research methods and techniques needed for these "problem-oriented" research efforts may be different from those needed in solely disciplinary inquiries. It is here that the combination of an M.Sc. degree, plus research training at an international agricultural research center, can provide a balanced research education and the experience to give most research workers a clear set of goals and the necessary research tools to function effectively in a national program.

Fifth, highly competent research officers who have demonstrated both their academic and on-the-job research ability should be selected for doctoral study. Station directors should only be considered for Ph.D. training if they maintain an active research program (i.e., at least 50% of their time is spent on research). Those directors who have clearly moved into an administrative capacity should be selected for short courses on research management and other training opportunities that would enhance their administrative and management ability. In addition, some younger research officers who show special aptitude for managerial or administrative roles, should be selected early for training in management practices so that a cadre of research managers can be built up.

Doctoral-level study is essential for developing a cadre of senior scientists who will provide scientific leadership and direction to the agricultural research system. There is no simple formula which can be

used to determine the exact number of agricultural research workers who should have Ph.D.s, but for the major commodities, a short-term goal would be to have at least one person with a doctorate in each of the primary disciplines.

Doctoral study is by its very nature theoretically oriented, and the doctoral thesis or dissertation is expected to be a "contribution to the body of knowledge" in a particular discipline. Unless an agricultural research worker is grounded in the problems of Kenya and the role of agricultural research in solving these problems, it is easy for a doctoral student to lose sight of these goals. Too often doctoral students studying in foreign universities become enamored of the goal of pushing back the frontiers of knowledge as defined by the scholarly profession through its international journal(s), and cannot apply this new knowledge and skill to the agricultural problems of their home country. For these reasons, considerable care and specific criteria should be used when selecting and sending an agricultural research worker for doctoral study, especially at a foreign university.

Finally, senior scientists who have established a good record of research productivity should be rewarded with opportunities to attend appropriate conferences and workshops in their fields of study. After 7 to 10 years of productive work following their highest degree, every effort should be made to arrange a research fellowship (six months to one year) or a position as a visiting scientist at an IARC. This will help senior officers to "recharge their research batteries," expose them to new research methods and materials, and help to establish professional working ties with IARC scientists and with scientists in other national programs.

Local versus Overseas Postgraduate Training

A major issue that clearly must be resolved in formulating a training strategy is the balance between local and overseas training. The advantages of postgraduate training overseas for Kenyan agricultural research scientists can be itemized as follows. (1) There is much greater scope for specialization than is at present possible at the University of Nairobi. (2) Courses are programmed and advertized well in advance. (3) Students are better able to concentrate on their studies full time without so many of the distractions they face when undertaking M.Sc. courses in Kenya (especially during the second, "practical" year in the field) and are, therefore, more likely to complete their courses on time. (4) Most courses are well established and have excellent facilities, and the student is able to work with highly experienced scientists in a new and stimulating academic environment.

There are, however, a number of disadvantages associated with overseas agricultural postgraduate training. First, there is the problem that unless syllabi can be tailored to the conditions that prevail in East Africa, some courses may be largely irrelevant. Similarly, it is important that M.Sc. and Ph.D. dissertations and theses are on topics that are of direct concern to Kenya -- in most cases, this means that some field work must be undertaken in Kenya. Recently, a few donors have made provision for students to return to Kenya for periods of up to a year to do their field research and then return to their overseas university to write. While this does increase the costs of overseas training (although only by a return air fare), we believe that this is outweighed by the additional benefits which are likely to accrue.

Second, married students with families are, quite understandably, reluctant to study overseas if it means they must go on their own, as is normally the case. Third, there is always the danger that a student will not return home immediately after completing the course. While this is usually not permanent, delays are common, and frustrate manpower development plans.

Finally, there is the cost factor. From Table 35 it can be seen that the annual costs for M.Sc. courses in the United Kingdom and the United States are at present over three times the equivalent figure for the University of Nairobi, and it is unlikely that this differential will be reduced during the next 5 to 10 years. Some would argue that, from an "opportunity cost" point of view, since most overseas training is paid for by donors who would not otherwise use this money to sponsor students at the University of Nairobi, comparing costs in this way is misleading.

Table 35. Annual Costs of M.Sc. (agriculture) Courses Overseas and in Kenya 1981 (Kenya Shillings).

	United Kingdom	United States	University of Nairobi
Tuition Fees	56,250	36,920	29,000
Accom. and Subsistence	60,525	63,024	7,700
Book Allowance	2,000	4,000	2,800
Insurance (medical)	2,000	1,410	---
Airfares (return)	18,406	22,476	---
	139,181	127,830	39,500
	K£6,959	K£6,391	K£1,975

Source: Unpublished data, Directorate of Personnel Management.

However, given the high cost of overseas courses, in addition to the other factors enumerated above, there is strong support for the case that greater emphasis should be given to developing agricultural postgraduate training at the University of Nairobi. Overseas postgraduate training therefore, should not be viewed as a long-term solution to providing high level agricultural manpower in Kenya, but rather as a short-term remedy for solving the most pressing manpower shortages. Given sufficient commitment, resources, and technical assistance, it should be possible to train at the University of Nairobi approximately 70% to 75% of the M.Sc. and 20% of the Ph.D. agricultural research trainees that will be required during the next five years. The capital and recurrent expenditures

required for this expansion have yet to be determined, and this scenario must therefore be considered "unconstrained." Yet, given the urgent demands for large increases in the number of agricultural postgraduates, coupled with the three-fold difference in annual costs for locally and overseas trained students, it seems probable that a very good case could be made for this investment.

CHAPTER 8

MANPOWER ALLOCATIONS AND TRAINING REQUIREMENTS FOR CROPS RESEARCH

The development of a training program for research personnel from a general strategy requires at least a general specification of agricultural research priorities for the country. As was discussed in Chapter 5, such a specification is not yet available, and any proposed training program must therefore be tentative and liable to considerable modification. However, based on the general priority guidelines (discussed in Chapter 5) for arriving at a pattern for allocating new staff to major research areas, we have developed a training program broken into details of disciplines within commodity research areas. While close attention has been paid to the views expressed in discussions with many government officials in order to be as realistic as possible, this exercise is essentially an illustration of the process that must be carried out when strategy for training and priorities for research have been decided upon. It is not intended to be exhaustive.

As discussed in Chapter 5, priority has been given to developing an increased capacity for research into improving intensive small-farmer systems, and for more applied and adaptive research to match technologies and practices to farmers' problems and circumstances. Balanced research teams of minimal "critical mass" are needed for major commodities. This does not imply a neglect of the essential central research services provided by more discipline-oriented research groups, but a judgment that these areas are comparatively better off in terms of staff resources than are the more needy areas.

This section of the report therefore focuses largely on commodities and to a lesser extent on farming systems research in order to shift the attention to programmatic concerns vis-à-vis manpower and training. Since only the Katumani station has a relatively strong farming systems orientation, this particular programmatic focus is not explicitly represented in the following analysis. However, it is recommended that more resources should be allocated to on-farm adaptive research as an essential function in the technology development process.

Because there is little on-farm adaptive research currently underway in Kenya, we have recommended that additional agronomists and agricultural economists be recruited, but we have not specified how they should be organized. Perhaps more attention should be given to this type of research at the regional research stations. On the other hand, given adequate transportation, perhaps a larger program with mobile teams might work more effectively, such as is the case at Katumani. Regardless of how these organizational issues are decided, it is apparent that if the agricultural research system is going to develop location-specific recommendations that will be adopted by farmers, and if crop research officers are to link effectively with the subject matter specialists under the new national extension plan being developed, the research system must commit additional manpower and other resources to on-farm adaptive research.

Current Stocks and Recommended Allocations of Crops Research Officers

The format of the analysis in this section comprises two tables for each commodity. The first table shows the total number of research officers (including expatriates) working on each commodity, by discipline. For the Kenyan research officers, data on highest educational qualification and years of experience are also presented.

In the second table current stocks are subdivided into experienced and inexperienced categories, with an experienced research officer being defined as an individual with an M.Sc. degree and five or more years of experience. On the basis of an analysis of these current stocks and the general research priorities identified by Kenyan policy-makers, additional numbers of research officers have been allocated, the objective being to ensure that each commodity program has the "critical mass" of staff necessary to conduct an effective research program. Since we are following a constrained demand approach, only about 15 new crops research officers can be added each year (in addition to replacing staff lost through attrition). Therefore, the specific allocations for each year during 1983 to 1987 are made on the basis of their priority or urgency within that particular commodity area.

It must be stated that the analysis has been carried out on the data available at the time of the visit. There are several gaps and more "DKs" (don't know) than we would have wished. However, we believe the information is accurate enough to support the general conclusions about the training pattern that is needed.

Table 36a. Number of Maize Research Officers by Discipline, 1982.

	Formal Qualifications						Years Work Experience					
Discipline	Tot[1]	B/Gn	B/Ag	MSc[2]	PhD	Dk[3]	0-2	3-4	5-6	7-10	10+	Dk[3]
Breeders	19(20)	8	2	8	0	1	10	1	2	2	3	1
Agron.	7(7)	0	3	3	1	0	1	3	0	0	3	0
Entomol.	0(0)	0	0	0	0	0	0	0	0	0	0	0
Pathol.	2(2)	0	2	0	0	0	2	0	0	0	0	0
Soil Scien.	3(3)	0	2	0	1	0	2	0	0	1	0	0
Chemists	2(2)	0	1	1	0	0	1	0	0	0	1	0
Totals	33(34)	8	10	12	2	1	16	4	2	3	7	1

These notes apply to Tables 36 to 50, 76 to 84, 89 to 90, and 92 to 93.
Note: 1( ) = Total number of scientists including expatriates.
2 = Includes postgraduate diplomas.
3 DK = Don't know, since this information was not available for some research officers.

Table 36b. Recommended Net Increases of Maize Research Officers by Discipline, 1983 to 1987.

	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
Discipline	Exp.[1]	Inexp.[2]	1983	1984	1985	1986	1987	Total
Breeders	7	12	-3	0	0	0	0	0
Agronomists	3	4	+3	1	1	1	1	4
Entomologists	0	0	1*	1*	1*	1*	1*	5*
Pathologists	0	2	0	1	0	1	0	2
Economists	0	0	1	0	1	0	1	3
Chemists	1	1	0	0	0	0	0	0
Soil Scien.	1	2	0	0	0	0	0	0
Totals	12	21	1	2	2	2	2	9

[1] Exp. = Experienced research officers having an M.Sc. degree and five or more years of experience.
[2] Inexp. = Inexperienced research officers having less than an M.Sc degree and/or five years of experience.

*Note: Given the apparent excess number of entomologists in other programs (e.g., the National Agricultural Laboratory) it might be possible to reassign these research officers and provide appropriate training, rather than employ new officers for these positions. Therefore these additions are not counted toward the overall net increase of 15 new officers per year. Also given the excess number of inexperienced breeders in the maize program it is recommended that three be shifted to agronomy and given appropriate IARC and/or postgraduate training.

Table 37a. Number of Wheat Research Officers by Discipline, 1982.

Discipline	Total	Formal Qualifications B/Gn	B/Ag	MSc	PhD	Dk	Years Work Experience 0-2	3-4	5-6	7-10	10+	Dk
Breeders	7(8)	0	1	5	1	0	0	5	0	0	2	0
Agron.	8(9)	1	3	4	0	0	5	2	0	0	1	0
Entomol.	4(4)	1	0	3	0	0	1	2	0	1	0	0
Pathol.	4(5)	0	0	4	0	0	2	2	0	0	0	0
Chem.	3(3)	0	3	0	0	0	3	0	0	0	0	0
Soil Phys.	4(4)	1	1	2	0	0	3	0	0	1	0	0
Econ.	4(4)	0	4	0	0	0	4	0	0	0	0	0
Others	1(1)	0	1	0	0	0	0	1	0	0	0	0
Totals	35(38)	3	13	18	1	0	18	12	0	2	3	0

Table 37b: Recommended Net Increases of Wheat Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982 Exp.	Inexp.	Research Personnel To Be Added from 1983 to 1987 1983	1984	1985	1986	1987	Total
Breeders	2	5	0	0	0	0	0	0
Agronomists	1	7	0	0	0	0	0	0
Entomologists	1	3	0	0	0	0	0	0
Pathologists	0	4	0	0	0	0	0	0
Economists	0	4	0	0	0	0	0	0
Chemists	0	3	0	0	0	0	0	0
Soil Physicists	1	3	0	0	0	0	0	0
Others	0	1	0	0	0	0	0	0
Totals	5	30	0	0	0	0	0	0

Since the wheat and barley research program has a relatively large research staff and has benefitted greatly from a major technical assistance program, no net additions to research scientist staff are recommended during this five-year period.

Table 38a. Number of Sorghum and Millet Research Officers by Discipline, 1982.

Occupation	Total	Formal Qualifications					Years Work Experience					
		B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeders	4(4)	1	0	3	0	0	2	2	0	0	0	0
Agronomists	3(4)	0	1	2	0	0	2	0	0	1	0	0
Soil Scien.	1(1)	1	0	0	0	0	1	0	0	0	0	0
Pathologists	1(1)	1	0	0	0	0	1	0	0	0	0	0
Irrigation	1(1)	0	1	0	0	0	1	0	0	0	0	0
Economists	1(1)	0	0	1	0	0	0	1	0	0	0	0
Totals	11(12)	3	2	6	0	0	7	3	0	1	0	0

Table 38b. Recommended Net Increases of Sorghum and Millet Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeders	0	4	0	0	0	1	0	1
Agronomists/ Physiologist	1	2	1	1	1	0	1	4
Entomologists	0	0	1	0	1	0	0	2
Pathologists	0	1	0	1	0	0	0	1
Economists	0	1	0	0	0	1	0	1
Food Technologists	0	0	0	0	1	0	1	2
Soil Scientists	0	1	0	0	0	0	0	0
Irrigation	0	1	0	0	0	0	0	0
Totals	1	11	2	2	3	2	2	11

Given the importance of sorghum and millet in the semi-arid areas of Kenya, it is recommended that the size of this program be increased sufficiently to ensure that there is a critical mass of research personnel who can conduct a viable sorghum and millet improvement program.

Backup from central research services in agrometeorological research will be essential.

Table 39a. Numbers of Rice Research Officers by Discipline, 1982.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeders	0(0)	0	0	0	0	0	0	0	0	0	0	0
Agronomists	1(1)	0	1	0	0	0	1	0	0	0	0	0
Entomologists	1(1)	1	0	0	0	0	1	0	0	0	0	0
Pathologists	1(1)	0	0	1	0	0	1	0	0	0	0	0
Economists	1(1)	1	0	0	0	0	1	0	0	0	0	0
Totals	4(4)	2	1	1	0	0	4	0	0	0	0	0

Table 39b. Recommended Net Increases in Rice Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeders	0	0	1	1	1	0	1	4
Agronomists/ Physiologist	0	1	1	1	0	1	0	3
Entomologists	0	1	0	0	0	1	0	1
Pathologists	0	1	0	0	1	0	0	1
Economists	0	1	0	0	0	0	1	1
Total	0	4	2	2	2	2	2	10

Since rice production is expanding rapidly, a concentrated research effort is needed to support the movement toward self-sufficiency. Therefore, an expanded, more comprehensive rice improvement program is recommended to serve two main rice-growing areas of Kenya (paddy rice in the Mwea-Tebera region and upland rice in the west). Backup in soil science from the central research services will be necessary.

Table 40a. Number of Grain Legume Research Officers by Discipline, 1982.

Discipline	Total	Formal Qualifications B/Gn	B/Ag	MSc	PhD	Dk	Years Work Experience 0-2	3-4	5-6	7-10	10+	Dk
Breeders	7(9)	1	2	4	0	0	5	1	0	0	1	0
Agronomists	6(6)	1	2	3	0	0	1	2	2	0	0	1
Soil Scientists	2(2)	1	0	1	0	0	1	0	0	0	0	1
Entomologists	1(1)	1	0	0	0	0	1	0	0	0	0	0
Pathologists	1(2)	0	0	0	0	1	0	0	1	0	0	0
Soil & Water Conservation/ Irrigation	2(2)	1	0	1	0	0	0	1	0	0	0	1
Totals	19(22)	5	4	9	0	1	8	4	3	0	1	3

Table 40b. Recommended Net Increases in Grain Legume Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982 Exp.	Inexp.	Research Personnel To Be Added from 1983 to 1987 1983	1984	1985	1986	1987	Total
Breeders	1	6	0	0	0	0	0	0
Agronomists/ Physiologist	2	4	0	0	1	0	0	1
Entomologists	0	1	1	1	0	1	0	3
Pathologists	1	0	0	1	0	0	1	2
Economists	0	0	0	0	1	0	0	1
Soils/ Irrigation	0	4	0	0	0	0	0	0
Totals	4	15	1	2	2	1	1	7

The current staffing situation includes eight or more Kenyans and two expatriates working on dry beans, with the remaining Kenyans and one expatriate working on cowpeas and pigeon peas. It is recommended that the main increases be in the cowpea and pigeon pea programs, particularly in the plant protection area.

Table 41a. Number of Potato Research Officers by Discipline, 1982.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeders	2(2)	0	1	0	0	1	1	0	C	0	0	1
Agronomists	3(3)	0	2	1	0	0	2	1	0	0	0	0
Entomologists	2(2)	1	0	1	0	0	0	2	0	0	0	0
Pathologists	4(4)	1	1	2	0	0	3	0	0	0	1	0
Economists	1(1)	0	0	1	0	0	0	0	1	0	0	0
Food Science & Technology	1(1)	0	1	0	0	0	0	1	0	0	0	0
Totals	13(13)	2	5	5	0	1	6	4	1	0	1	1

Table 41b. Recommended Net Increases in Potato Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeders	0	2	0	0	0	0	0	0
Agronomists	0	3	0	0	0	0	0	0
Entomologists	0	2	0	0	0	0	0	0
Pathologists	1	3	0	0	0	0	0	0
Economist	1	0	0	0	0	0	0	0
Food Science & Technology	0	1	0	0	0	0	0	0
Totals	2	11	0	0	0	0	0	0

The potato research staff appears to have sufficient size and balance at the present time, therefore, no new additions are recommended. New additions in the root and tuber area should be added to in the areas of yam/sweet potato and cassava research, particularly in the coastal area. These recommended increases are found in the following set of tables.

Table 42a. Number of Root and Tuber Research Officers by Discipline.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeders	0(0)	0	0	0	0	0	0	0	0	0	0	0
Agronomists	1(1)	0	1	0	0	0	1	0	0	0	0	0
Entomologists	0(0)	0	0	0	0	0	0	0	0	0	0	0
Pathologists	0(0)	0	0	0	0	0	0	0	0	0	0	0
Totals	1(1)	0	1	0	0	0	1	0	0	0	0	0

Table 42b. Recommended Net Increases in Roots and Tubers Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeders	0	0	1	1	1	1	0	4
Agronomists	0	1	1	0	1	0	1	3
Entomologists	0	0	1	0	1	0	0	2
Pathologists	0	0	0	1	0	1	0	2
Economists	0	0	0	0	0	0	1	1
Totals	0	1	3	2	3	2	2	12

It is recommended that a major expansion be made in the roots and tuber program, with about one-half of these new staff to be added to the coastal zone and the other one-half being added to an upland station to serve the needs of smallholders with intensive farming systems.

Table 43a. Number of Oil Seed Research Officers by Discipline, 1982.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeders	0(0)	0	0	0	0	0	0	0	0	0	0	0
Agronomists	5(6)	0	1	4	0	0	1	2	1	1	0	0
Entomologists	1(1)	1	0	0	0	0	0	1	0	0	0	0
Pathologists	1(1)	0	0	1	0	0	1	0	0	0	0	0
Totals	7(8)	1	1	5	0	0	2	3	1	1	0	0

Table 43b. Recommended Net Increases in Oil Seeds Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeders	0	0	1	1	1	1	0	4
Agronomists	2	3	0	0	0	0	1	1
Entomologists	0	1	1	0	1	1	0	3
Pathologists	0	1	0	1	0	0	0	1
Economists	0	0	0	1	0	0	0	1
Totals	2	5	2	3	2	2	1	10

Because of the large amount of vegetable oil that is imported annually into Kenya, high priority is being given to oil seeds research.

Table 44a. Number of Horticulture Research Officers by Discipline, 1982.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeders	4(5)	1	1	0	0	2	1	1	0	2	0	0
Agronomists	11(13)	2	4	5	0	0	4	3	0	1	2	1
Entomologists	6(6)	3	0	0	0	3	0	3	1	1	1	0
Pathologists	9(9)	4	1	4	0	0	7	2	0	0	0	0
Soil Scien.	2(2)	1	0	1	0	0	1	0	0	0	1	0
Economists	2(2)	1	1	0	0	0	1	1	0	0	0	0
Others	6(8)	3	2	0	0	1	3	0	1	0	0	2
Totals	40(45)	15	9	10	0	6	17	10	2	4	4	3

Table 44b. Recommended Net Increases in Horticulture Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeders	2	2	1	1	1	1	1	5
Agronomists	3	8	0	0	0	0	0	0
Entomologists	3	3	0	0	0	0	0	0
Pathologists	0	9	0	0	0	0	0	0
Economists	0	2	0	0	0	0	0	0
Soil Scien.	1	1	0	0	0	0	0	0
Others	0	6	0	0	0	0	0	0
Totals	9	31	1	1	1	1	1	5

The current breakdown of the horticulture research staff includes officers in vegetable research, general horticulture, tree crops (coconut and cashew), fruit crops, and floriculture. There is a good balance of disciplines in each area except for vegetable breeding. The cash crops (tree crops and floriculture) have a relatively small number of research officers, and modest increases are recommended to achieve a critical mass of researchers in these areas. The six officers who are not working on any particular program might be assigned to and trained for these program areas. There was insufficient information about the type of research being conducted by the general horticulturalists to know how they are allocating their time. Generally more effort is needed in vegetable breeding to develop better adapted varieties. This objective might be achieved by reassigning and/or training existing staff, but five additional officers have been added to fill existing gaps in the horticulture program.

Table 45a. Number of Coffee Research Officers by Discipline, 1982.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeders	2(3)	0	0	2	0	0	0	0	1	1	0	0
Agronomists	4(4)	0	0	3	0	1	0	1	1	0	1	1
Entomologists	2(2)	0	0	2	0	0	0	0	0	1	1	0
Pathologists	3(3)	0	1	1	1	0	0	0	2	0	1	0
Economists	2(2)	0	1	1	0	0	0	0	0	1	1	0
Not known	2(2)	0	1	1	0	0	0	0	0	1	1	0
Totals	15(16)	0	3	10	1	1	0	1	4	4	5	1

Table 45b. Recommended Net Increases in Coffee Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeders	2	0	0	0	0	1	0	1
Agronomists	2	2	0	0	0	0	0	0
Entomologists	2	0	0	0	0	0	1	1
Pathologists	2	1	0	0	0	0	0	0
Economists	1	1	0	0	0	0	0	0
Other	1	1	0	0	0	0	0	0
Totals	10	5	0	0	0	1	1	2

The coffee research staff is relatively well trained and experienced, therefore only modest increases are recommended at this time.

Table 46a. Number of Tea Research Officers by Discipline, 1982.

Discipline	Total	Formal Qualifications B/Gn	B/Ag	MSc	PhD	Dk	Years Work Experience 0-2	3-4	5-6	7-10	10+	Dk
Breeders	2(2)	0	0	2	0	0	0	0	1	0	1	0
Soil & Water conservation	1(1)	0	0	0	1	0	0	0	0	0	1	0
Chemists	1(1)	0	1	0	0	0	0	0	1	0	0	0
Totals	4(4)	0	1	2	1	0	0	0	2	0	2	0

Table 46b: Recommended Net Increases in Tea Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982 Exp.	Inexp.	Research Personnel To Be Added from 1983 to 1987 1983	1984	1985	1986	1987	Total
Breeders	2	0	0	0	0	0	0	0
Agronomists	0	0	1	0	0	1	0	2
Entomologists	0	0	1	0	0	0	0	1
Pathologists	0	0	1	0	0	0	0	1
Economists	0	0	0	1	0	0	0	1
Soil & Water Conservation	1	0	0	0	0	0	1	1
Chemists	1	0	0	0	1	0	0	1
Totals	4	0	3	1	1	1	1	7

Since tea is an important cash crop in Kenya, some increases in research staff appear warranted, particularly in the plant protection area. Although this crop is not now facing any serious pest problems, there should be a minimum capacity to deal with problems. Furthermore, more on-farm agronomic and economic research is needed in smallholder areas where production continues to be low and labor problems are arising.

Table 47a. Number of Pyrethrum Research Officers by Discipline.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gr	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeders	3(3)	1	0	2	0	0	1	1	0	0	1	0
Agronomists	2(2)	1	0	1	0	0	1	1	0	0	0	0
Pathologists	1(1)	1	0	0	0	0	0	1	0	0	0	0
Not known	1(1)	0	0	1	0	0	0	0	0	0	0	1
Totals	7(7)	3	0	4	0	0	2	3	0	0	1	1

Table 47b. Recommended Net Increases in Pyrethrum Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeders	1	2	0	0	0	0	0	0
Agronomists	0	2	0	0	0	0	0	0
Entomologists	0	0	0	0	0	0	0	0
Pathologists	0	1	0	0	0	0	0	0
Economists	0	0	0	0	0	0	0	0
Unknown	0	1	0	0	0	0	0	0
Totals	1	6	0	0	0	0	0	0

No increases in research personnel are recommended during the next five years. The emphasis during this period should be on upgrading the relatively inexperienced staff working in this area.

Table 48a. Number of Sugar Research Officers by Discipline, 1982.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeders	2(2)	1	1	0	0	0	1	1	0	0	0	0
Agronomists	3(3)	2	0	1	0	0	2	0	0	0	1	0
Pathologists	6(6)	5	0	0	1	0	1	2	0	0	2	1
Economists	2(2)	2	0	0	0	0	2	0	0	0	0	0
Chemists	2(2)	2	0	0	0	0	1	1	0	0	0	0
Soil Scientists	1(1)	0	0	1	0	0	0	0	0	1	0	0
Totals	16(16)	12	1	2	1	0	7	4	0	1	3	1

Table 48b. Recommended Net Increases in Sugar Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeders	0	2	0	0	0	0	0	0
Agronomists	1	2	0	0	0	0	0	0
Entomologists	0	0	+2	0	0	0	0	+2
Pathologists	1	5	-2	0	0	0	0	-2
Economists	0	2	0	0	0	0	0	0
Chemists	0	2	0	0	0	0	0	0
Soil Scientist	1	0	0	0	0	0	0	0
Processing	0	0	1	0	0	0	0	1
Totals	3	13	1	0	0	0	0	1

It appears there are too many pathologists currently assigned to the sugar research program. Since three officers are very recent B.Sc. (science) graduates and in need of further training, it is recommended that two be retrained as entomologists or be transferred to another commodity improvement program where they can work as plant pathologists. In addition, an increase is recommended in the "supporting" research area of sugar processing.

Table 49a. Number of Cotton Research Officers by Discipline, 1982.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeders	6(7)	4	0	2	0	0	1	3	1	1	0	0
Agronomists	6(6)	2	1	3	0	0	3	1	0	1	1	0
Entomologists	6(6)	2	0	4	0	0	2	2	0	2	0	0
Pathologists	1(1)	0	0	1	0	0	1	0	0	0	0	0
Totals	19(20)	8	1	10	0	0	7	6	1	4	1	0

Table 49b. Recommended Net Increases in Cotton Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeders	2	4	0	0	0	0	0	0
Agronomists	2	4	0	0	0	0	0	0
Entomologists	2	4	-2	0	0	0	0	-2
Pathologists	0	1	+2	0	0	0	0	+2
Economists	0	0	0	1	0	0	0	1
Totals	6	13	0	1	0	0	0	1

Again there is a problem of too many entomologists assigned to this research program. Since four of these entomologists are recent B.Sc. (science) graduates and two were employed in 1981, it is recommended that at least two be retrained as pathologists where they can be more useful to the cotton improvement program. It is also recommended that one or two economists be added to this program.

Table 50a. Number of Seed Quality Research Officers by Discipline, 1982.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeders	3(3)	1	1	1	0	0	2	0	0	0	0	1
Agronomists	6(6)	1	2	3	0	0	3	2	0	1	0	0
Pathologists	3(6)	1	1	1	0	0	1	2	0	0	0	0
Economists	2(2)	1	0	1	0	0	2	0	0	0	0	0
Inspectors	3(3)	1	2	0	0	0	3	0	0	0	0	0
Totals	17(21)	5	6	6	0	0	11	4	0	1	0	1

Table 50b. Recommended Net Increases in Seed Quality Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeders	0	3	0	0	0	0	0	0
Agronomists	1	5	0	0	0	0	0	0
Entomologists	0	0	1*	0	1*	0	1*	3*
Pathologists	0	3	0	0	0	0	0	0
Economists	0	2	0	0	0	0	0	0
Inspectors	0	3	0	0	0	0	0	0
Totals	1	16	0	0	0	0	0	0

* Since there appear to be excess entomologists in the overall research system, these three officers are considered to be available elsewhere in the system and have not been counted toward the overall net additions.

Maintaining and testing breeder and foundation seed does not require research staff per se, but rather well trained personnel who can carry out these functions. A dependable supply of seed is an essential part of getting improved genetic technology to farmers. It is interesting to note, however, that only two years ago there were only six research officers working in this area. The recent implementation of a donor-assisted project in seed quality and the availability of training funds has resulted in 11 new research officers being added to this program. Major shifts in research personnel to take advantage of training resources can be particularly detrimental to individual research programs.

Combined Recommendations of Net Increases in Manpower by Commodity and Discipline

The accumulated total of recommended increases in staff are given with respect to commodity in Table 51, and with respect to discipline in Table 52. The proposed staff totals by 1987 in Table 51 reflect priority emphasis by commodity and those in Table 57 priority emphasis by discipline. Increased emphasis is evident on the crops of the drier areas, sorghum and millet, and on rice, root crops, and oil seeds. For the disciplines extra emphasis falls on agronomy and economics, reflecting the need for farming systems research and on-farm adaptive research.

In Table 51 there is a large group, 144 research staff, not specified by commodity, and this group is not expected to expand in the short run. This is basically the central specialized research services, which is considered comparatively well supplied with research scientists. They have a very important role to play in supporting the commodity teams and assisting in development planning. Training requirements to a high level are particularly important with this group.

It should be noted that the increases in commodity specific research are not tied to any particular research station; they are generalized needs over the whole country.

Table 51. Current Size and Recommended Net Increase in Numbers of Research Officers by Commodity and Related Research Programs.

Discipline	Current Number of Research Staff	Recommended Net Increases	Expected Staff Size by 1987
Maize	33	14	47
Wheat and Barley	35	0	35
Sorghum and Millet	11	11	22
Rice	4	10	14
Grain Legumes	19	7	26
Potato	13	0	13
Other Roots and Tubers	1	12	13
Oil Seeds	7	10	17
Horticulture	40	5	45
Coffee	15	2	17
Tea	4	7	11
Pyrethrum	7	0	7
Sugar	16	1	17
Cotton	19	1	20
Seed Quality/Cert.	17	3	20
Research Officers not Commodity Specific/ Not Specified	144	-8	136
Totals	385	75	460

Table 52. Current Size and Recommended Net Increases in the Number of Research Officers by Discipline.

Discipline	Current Number of Research Staff	Recommended Increases	Expected Staff Size by 1987
Breeding and Genetics	60	16	76
Agronomy	74	21	95
Soils & Plant Nutrition	34	1	35
Soil Physics, etc.	21	0	21
Entomology	52	13	65
Plant Pathology	51	10	61
Irrigation/Soil & Water Cons.	23	0	23
Ag. Econ./Biometry, etc.	28	10	38
Chemistry/Food Sciences/ Tech.	17	3	11
Others (incl. Admin)	7	1	8
Not Specified	18	0	18
Totals	385	75	460

The Supply of Crops Research Officers

The main source of recruitment of B.Sc. graduates into the agricultural research system has been, and will continue to be for at least the next 5 to 10 years, the University of Nairobi. The Report of the Second University Commission published in September 1981 recommends the establishment of a second university in Kenya, which will include a faculty of agriculture with a planned student enrollment of 800 and a teaching and research staff of 60. It seems unlikely, however, that the first outputs from this new institution will be produced before 1990. In view of the 5- to 10-year horizon of this report, coupled with the urgency of increasing and upgrading the stocks of agricultural research scientists in Kenya, we have focused exclusively on achieving improvements in recruitment and training from existing sources of supply.

Prior to the establishment of the Faculty of Agriculture at the University of Nairobi in 1970, most Kenyan agricultural research scientists received their undergraduate training at Makerere University in Uganda, part of the Federal University of East Africa which was disbanded in 1970. As mentioned earlier, it was originally intended that the Faculty of Agriculture produce 40 graduates per year. It soon became clear, however, that this was inadequate, and during the 1970s the Faculty of Agriculture received assistance from IBRD (the World Bank) under the education credits project, which expanded student capacity from 120 to 300. This will shortly increase to 690, with a projected annual output of 200 undergraduates and 30 M.Sc./Ph.D. postgraduates in all fields (including range management, agricultural engineering, animal production, etc.). Past and projected outputs from the Faculty of Agriculture are presented in Table 53.

Data on foreign-trained undergraduates are difficult to obtain. Students attending overseas training institutions are formally obliged to register with the Ministry of Higher Education, but many, especially those who are privately sponsored, fail to do so. An unsuccessful attempt was made to introduce a comprehensive card index system for overseas trainees in the mid-1960s. Given the continued importance of overseas training for Kenyans we recommend that the Ministry of Higher Education seek assistance in developing a new system utilizing the latest advances in microcomputer technology.

B.Sc. (science) graduates from the University of Nairobi and Kenyatta University College are the other major sources of recruits for the agricultural research service. Of the 385 crop research scientists in 1982, some 62% could be identified as being B.Sc. (science) graduates. And with the recent rapid expansion of recruitment into the Ministry of Agriculture, B.Sc. (science) graduates have become an increasingly important source of supply -- over 50 out of a total intake of approximately 70 in 1981/82.

The quality of the intake into the B.Sc. (agriculture) program is considered adequate by the Dean of the Faculty of Agriculture. However, it is interesting to note that the minimum "cut point" scored in "A"-level examinations by the 1981/82 intake into the B.Sc. (agriculture) program was only seven, closely followed by the B.Sc. (science) intake with a cut point of eight (see Table 54). It is apparent, therefore,

Table 53. Past and Projected Supply of Agricultural and Veterinary Graduates and Postgraduates from the University of Nairobi, 1971 to 1987.

DEGREE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	Est. 1982	Est. 1983	Est. 1984	Est. 1985	Est. 1986	Est. 1987
B.Sc. Agriculture	-	-	40	41	40	53	43	59	69	66	92	100	120	140	150	160	180
B.Sc. Food Tech.	-	-	-	-	-	8	9	10	16	17	15	15	20	20	20	20	20
B.Sc. Agric. Engr.	-	-	-	-	-	-	-	-	6	10	15	15	20	20	20	20	20
B.Sc. Forestry	-	-	-	-	-	-	-	-	-	8	13	16	20	25	25	30	30
Postgrad. Irrig.	-	-	-	-	-	-	-	12	-	16	-	-	-	-	-	-	-
Diploma Soil Cons.	-	-	-	-	-	-	-	-	-	11	-	na	na	na	na	na	na
M.Sc. Agriculture	-	-	2	2	2	12	17	2	18	32	34	30	30	30	30	30	30
Ph.D. Agriculture	-	-	2	-	1	-	1	1	2	1	-	2	1	2	2	2	3
B. Vet. Med. (BVM)	44	47	55	51	69	50	75	76	74	74	65	89	92	96	96	96	96
M.Sc. Vet. Med.[1]	-	1	8	3	3	2	3	1	6	1	2	3	4	5	6	8	10
Ph.D. Vet. Med.[1]	2	-	2	1	1	-	1	2	2	-	1	2	2	2	3	3	3

Source: University of Nairobi and IBRD, Evaluation Reports of Education Credit Projets. (various).

Table 54. University of Nairobi 1981/82 Admissions Summary.

Faculty/Department	Cut Point	Kenyans	Non-Kenyans	Sub-Total	Grand Total
B.Sc. (Agricultural Engineering)	11*	18	-	18	
B.Sc. (Agriculture)	7	83	1	84	
B.Sc. (Food Science & Technology)	11	20	3	23	153
B.Sc. (Forestry)	7	16	2	18	
B.Sc. (Range Management)	7	10	-	10	
Bachelor of Arch. Des. & Dev.	12*	41	1	42	
B.A. (Building Economics)	11	29	1	30	
B.A. (Land Economics)	11*	26	-	26	116
B.A. (Design)	10	17	1	18	
Bachelor of Arts	10	449	17	466	466
Bachelor of Commerce	12	185	-	185	185
Bachelor of Education (Arts)	10	352	0	352	
Bachelor of Education (Science)	7	295	1	296	674
B.A. Fine Art	7	26	-	26	
B.Sc. Civil Engineering	12*	67	2	69	
B.Sc. Electrical Engineering	13*	49	4	53	189
B.Sc. Mechanical Engineering	12*	45	1	46	
B.Sc. Surveying Photogrammetry	11	18	3	21	
Bachelor of Law	14*	90	1	91	91
Bachelor of Dental Surgery	8	13	4	17	
Bachelor of Pharmacy	11*	29	1	30	151
M.B. Ch.B.	9*	97	7	104	
Bachelor of Science	8	356	23	379	379
Bachelor of Veterinary Medicine	8	81	13	94	94
TOTAL	-	2412	86	2498	2498

* First choice only.

Source: Assistant Registrar Admissions, University of Nairobi.

that compared with subjects such as engineering, commerce, and law, agriculture and science are relatively less popular among candidates eligible for the University of Nairobi. Moreover, in view of the current expansion of the Faculty of Agriculture it is important to consider where these new students are going to come from. Increasing the intake of marginally qualified students who may be more interested in a university

degree than in studying agricultural science may result in a considerable waste of resources. Clearly most undergraduate recruits will continue to be "A"-level school leavers (secondary school graduates) but alternative sources should also be considered. Diploma-holders from Egerton College are a distinct possibility. This will be discussed further in Chapter 12.

With regard to the quality and relevance of graduates from the Faculties of Agriculture and Science, we encountered some differences of opinion within the research community concerning the relative worth of B.Sc. (agriculture)- and (science)-degree holders. The Scientific Research Division (SRD) of the Ministry of Agriculture prefers to recruit as many high quality B.Sc. (agriculture) graduates as possible, but the extension division has generally been given first priority in recruiting the available agriculture graduates. SRD has been obliged, therefore, to recruit B.Sc. (science) graduates who have little specific knowledge of agriculture and what agricultural research entails. However, other scientists we spoke to argued that, on the contrary, agriculture graduates were less suited to agricultural research since their training is oriented primarily towards acquiring production knowledge and skills. In view of the importance of strengthening applied and adaptive research in Kenya, we recommend that the proportion of high quality agriculture graduates be increased since their formal university training is most appropriate for these types of research activities, but we should stress that both types of graduates require further training appropriate to a career in agricultural research.

The quality of the degree attained by graduates is another important consideration since most universities stipulate that entrants into postgraduate programs have an upper second- or first-class degree. Some scientists have questioned the importance that is currently attached to the class of degree attained, arguing that it has been a poor predictor of subsequent performance. It is nevertheless the crucial criterion in determining acceptance for postgraduate courses at overseas universities which, unlike the Faculty of Agriculture at the University of Nairobi, are not usually prepared to waive minimum entry requirements for postgraduate courses. Therefore, if the goal is to raise the minimum academic qualifications of all research officers to the M.Sc level, then only graduates who can be admitted into postgraduate programs should be initially accepted into the agricultural research system.

The Faculty of Agriculture only began to grade B.Sc. (agriculture) degrees in 1980. During the last two years, 21 (60%) of the 36 B.Sc. (agriculture) recruits who could be identified had upper second degrees. The situation with regard to the B.Sc. (science) intake is, however, considerably more worrying -- only 19% of the 50 B.Sc. (science) graduates from the University of Nairobi in 1981 whom we were able to identify had upper second degrees. We, therefore, strongly recommend that strenuous efforts be made in the future to ensure that a high proportion of recruits (if not all) have upper second degrees.

Finally, it is necessary to estimate the likely supply of graduates from existing sources into the agricultural research system during 1983 to 1987. During recent years about 20% to 25% of B.Sc. (agriculture) graduates have been recruited into the research service. This is a marked improvement on earlier years when only about 10% of these graduates found their way into agricultural research (see Table 55). If

Table 55. B.Sc. and M.Sc. Graduates from Nairobi University Employed in the Agricultural Research Sector 1972/73 to 1980/81.

	72/3	73/4	74/5	75/6	76/7	77/8	78/9	79/80	80/1
B.Sc. Agriculture	5/39	4/40	5/40	3/31	14/43	21/59	21/69	10/56	21/89
%	12.8	10.0	12.5	9.7	32.6	35.6	30.4	17.8	23.6
B.Sc. Food Science and Technology	---	---	---	1/8	4/9	0/10	3/16	2/17	3/15
%				12.5	44.4	0.0	18.7	11.8	20.0
M.Sc. Agriculture	---	1/2	0/2	1/12	1/17	1/2	6/18	13/32	7/34
%		50.0	0.0	8.3	5.9	50.0	33.3	40.6	20.6

Source: University of Nairobi, Graduation Lists (Various).

it is assumed that similar proportions will continue to be recruited during the next five years, then approximately 150 agricultural graduates will become available. According to our constrained demand projections, no more than 200 graduates will need to be recruited into crops research from 1983 to 1987 and hence the projected supply from the Faculty of Agriculture should be nearly adequate. However, the question of whether or not agricultural research will receive a high proportion of upper second class graduates remains open.

The other side of the supply issue concerns the B.Sc (science) graduates. From our projections it appears that the current number of B.Sc. (science) recruits will need to be considerably curtailed. In fact there is growing concern about the rapid increase in the numbers of B.Sc. (science) graduates who are seeking employment in the agricultural research sector as an alternative to taking up what are considered to be low status (although not lower paid) jobs in secondary- and tertiary-level training institutions where there are chronic shortages of university-trained teachers. While the government's concern to provide employment for all university graduates is appreciated, the future size of the agricultural research sector must be determined according to its ability to productively absorb graduate-level manpower, and not purely on the basis of supply side considerations. The Directorate of Personnel Management has recognized this problem, and the present attempt to channel B.Sc. (science) graduate recruitment into the ministries through the Public Services Commission will help to ensure that these graduates are placed where the greater shortages exist, rather than as the result of the uncoordinated recruitment efforts of each individual ministry. We support this move and recommend its extension to other categories of manpower.

Recommended Training Plan by Commodity Area for 1983 through 1987

Two basic types of training are included in the following training plan for crops research officers. Formal degree training at the M.Sc. and Ph.D. levels and short-term research training (usually 3 to 12 months) at the international agricultural research centers, or similar courses/programs at other institutions (such as the soybean production course at the University of Illinois or the International Course for Development-Oriented Research in Agriculture (ICRA) at Wageningen, the Netherlands).

The training plan has not been costed, and financial resources have not been considered a constraint. To that extent this is an unconstrained plan. However, the rationale of the argument for the training strategy was that postgraduate training in research methodology is essential for development of a viable and productive research officer, and it is best done relatively quickly and professionally. It is unrealistic to regard a research officer as productive in research before completion of such training either formally, or informally over a much longer period. Moreover, the postgraduate training process is a short-term development expense for each officer, not a recurring commitment. The major constraint in planning therefore, is the recurring provision of salary; the necessary training element should not be considered a determining constraint. However, it may well be necessary to seek special development funding to support the essential training element.

Formal Degree Training

As recommended in the chapter on the training needs of research personnel, all research officers should have an M.Sc. degree, and those officers who demonstrate competence through effective research performance, and who have the intellectual ability, should be sent for Ph.D.-level training. At the present time slightly more than 40% of the research staff have or are working toward postgraduate qualifications (approximately one-third of this group are currently in training for postgraduate degrees, nearly all at the M.Sc. level).

Formal degree training requirements have been derived by examining the current educational qualifications of the research staff for each commodity. It has been assumed that net additions of new plus replacement staff will enter with B.Sc. degrees. This additional number of new staff has then been added to the current number of B.Sc. research officers. It is recommended that approximately two-thirds of B.Sc.-holders should begin M.Sc. studies during 1983 through 1987. Obviously the sequencing of this postgraduate training must be evenly distributed over the plan period, so that the ongoing research programs are not seriously impaired. This recommendation is also predicated on the expectation that a majority of the recommended M.Sc. training will be carried out at the University of Nairobi, in which case, the typical research officer would spend nine months in course work at Kabete, followed by about a year of thesis research work back at his/her experiment station. This will minimize the amount of time research officers are absent from thir stations, and ensure that their thesis research is related to their regular research assignments.

With regard to Ph.D.-level training, it is necessary to examine how many M.Sc.-holders are currently available, by discipline, in each commodity area. The recommended level of Ph.D. training during the plan period will be to select at least one current M.Sc.-holder per discipline. In many disciplines and even some commodity areas, there are currently no M.Sc.-holders, therefore the immediate training goal will be to build up a cadre. In areas and disciplines where there are M.Sc.-holders, the goal will be to select and send from 20% to 50% of this group for Ph.D. training. This general recommendation is based on several assumptions. First, probably not more than half of this group are actually academically qualified or otherwise in a position to pursue Ph.D.-level training (e.g., age, family reasons, etc.). Second, since the typical doctoral degree program will take from three to four years to complete, it is not advisable for a research program to have more than half of its senior staff away on postgraduate training at any one time. Therefore, the absorptive capacity of the agricultural research systems for Ph.D. fellowships during the current plan period will be somewhat limited. In the following five-year period (1988 to 1992), more scope will be available for doctoral-level training.

Short-Term Research Training at International Research Centers

For crops research, the ideal strategy will be to send new graduates who have been in the research system for a minimum of one year, for a short course at an appropriate IARC, if the IARCs can possibly accommodate them. There are also a few alternative short courses available, but none are likely to be able to take more than two or three trainees per year in any particular program. In view of the present backlog, it will not be feasible for everyone to go on such courses within two years of appointment. This is regrettable, because of the special value of such courses, but it should not be allowed to unduly delay entrance into a formal M.Sc. course. The short course places available should perhaps be reserved for recent recruits.

In addition to short-term research training for relatively inexperienced research officers, it is also recommended that mid-career scientists (M.Sc.- or Ph.D.-level scientists with seven or more years of experience) be sent to IARCs for specialized training or for refresher courses as visiting scholars, fellows, or scientists (the particular type of program depending on the IARC and the qualification of the individual being sent). Since research scientists in Kenya are relatively young and inexperienced, only a few trainees have been allocated in this area. However, in the next plan period (1988 to 1992) the need for this type of training is likely to increase, while the early-career IARC research training will need to be reduced to a maintenance level. This will ensure a continuing relationship between the national program and the IARC.

While the available information concerning the numbers of Kenyan research scientists who have completed short courses overseas is somewhat fragmentary, from the manpower data provided by the Director of Research, Ministry of Agriculture, it is clear that very few scientists have had the opportunity to attend these courses. This also probably accounts for the relatively modest number of officers who are currently being recommended for short-term training courses at IARCs and elsewhere by their station directors -- only 38 in all. From the following analysis it will be seen that we are recommending about a two-fold increase in the extent of short-term research training overseas.

Training Plan by Commodity Area

Separate training plans have been tentatively developed for each commodity area. Since the general strategy for this training was presented earlier, these plans are presented with only brief explanatory comments, and are summarized at the end of this section. The candidates for training include not only the net new additional staff to be recruited as set out in Tables 36 through 52, but also the new recruits to replace those staff lost by normal attrition.

Maize Research Training

Table 56. Number of Training Grants Required for Maize Research Officers at the M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Recruitment for Attrition	Net Additions at B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	10	8	0	1	5	-3	8	3
Agronomists	3	3	1	0	2	7	8	1
Entomologists	0	0	0	0	0	5	3	0
Pathologists	2	0	0	0	1	2	3	0
Ag. Econ.	0	0	0	0	0	3	2	0
Soil Scien.	2	0	1	0	1	0	3	0
Chemists	1	1	0	0	1	0	2	0
Total	18	12	2	1	10	14	29	4

* Includes all staff currently in training at the degree level they will achieve upon return.

The International Maize and Wheat Improvement Center (CIMMYT) has excellent research training programs for researchers working in maize improvement. The team recommends that training opportunities be requested at CIMMYT for four Kenyan maize researchers in 1983, six in 1984, five in 1985, five in 1986, and four in 1987. After the fifth year, CIMMYT maize training should be maintained at about two trainees per year and supplemented with advanced training opportunities for senior research officers (one per year).

Wheat Research Training

Table 57. Number of Training Grants Required for Wheat Research Officers at the M.Sc. and Ph.D. Levels, 1982 to 1987.

Discipline	Current Staff by Qualification*				Recruitment for Attrition	Net Additions at B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	1	5	1	0	2	0	2	1
Agronomists	4	4	0	0	2	0	4	2
Entomologists	1	3	0	0	1	0	1	1
Pathologists	0	4	0	0	1	0	1	1
Economists	4	0	0	0	1	0	3	0
Chemists	3	0	0	0	1	0	2	0
Soil Physicists	2	2	0	0	1	0	2	1
Others	1	0	0	0	0	0	0	0
Totals	16	18	1	0	9	0	15	6

* Includes all staff currently in training at the degree level they will achieve upon return.

While the wheat and barley research program has received considerable external support for postgraduate training, additional wheat research training at CIMMYT is necessary. The team recommends that training opportunities be requested at CIMMYT for three Kenyan wheat researchers in 1983, three in 1984, three in 1985, two in 1986, and four in 1987.

Sorghum and Millet Research Training

Table 58. Number of Training Grants Required for Sorghum and Millet Research Officers at the M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Recruitment for Attrition	Net Additions at B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	1	3	0	0	1	1	2	1
Agronomists	1	2	0	0	1	4	4	1
Entomologists	0	0	0	0	0	2	1	0
Pathologists	1	0	0	0	0	1	1	0
Economists	0	1	0	0	0	1	1	0
Soils/Irr.	2	0	0	0	1	0	2	0
Food Techn.	0	0	0	0	0	2	1	0
Total	5	6	0	0	3	11	12	2

* Includes all staff currently in training at the degree level they will achieve upon return.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) offers excellent research opportunities for young research officers, frequently in combination with M.Sc. degree programs. While some officers have received training at ICRISAT, we lack data on the level and type of training received. Nevertheless, our tentative recommendations are for two Kenyan sorghum and millet researchers to be trained at ICRISAT in 1983, three in 1984, three in 1985, three in 1986, and two in 1987.

Rice Research Training

Table 59. Number of Training Grants Required for Rice Research Officers at M.Sc. and Ph.D. Levels, 1983 to 1987.

	Current Staff by Qualification*				Recruitment for Attrition	Net Additions at B.Sc. Level	Num. of Grants Required	
Discipline	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	0	0	0	0	0	4	2	0
Agronomists	1	0	0	0	0	3	3	0
Entomologists	1	0	0	0	0	1	1	0
Pathologists	0	1	0	0	0	1	1	0
Economists	1	0	0	0	0	1	1	0
Totals	3	1	0	0	0	10	8	0

* Includes all staff currently in training at the degree level they will achieve upon return.

Since it is recommended that there is a major expansion in rice research in Kenya, it will be necessary to upgrade the skills of the research staff as quickly as possible. It is recommended that paddy rice researchers be sent to IRRI, but that researchers working on upland rice research be sent to IITA since it appears to have a more appropriate upland rice research training program. The team believes that places should be sought for two Kenyan rice researchers in 1983, two in 1984, one in 1985, two in 1986, and three in 1987.

Grain Legume Research Training

Table 60. Number of Training Grants Required for Grain Legume Research Officers at the M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Recruitment for Attrition	Net Additions at B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	3	4	0	0	2	0	3	1
Agronomists	3	3	0	0	2	1	4	1
Entomologists	1	0	0	0	0	3	2	0
Pathologists	0	1	0	0	0	2	1	1
Economists	0	0	0	0	0	1	1	0
Soils/Irrig.	2	2	0	0	1	0	2	1
Totals	9	10	0	0	5	7	13	4

* Includes all staff currently in training at the degree level they will achieve upon return.

The International Center for Tropical Agriculture (CIAT) in Colombia has training programs for researchers working in bean production. The team recommends that places be sought for training at CIAT for one Kenyan researcher in 1983, two in 1984, one in 1985, one in 1986, and one in 1987.

The International Institute of Tropical Agriculture (IITA) in Nigeria is the IARC responsible for cowpea research, while ICRISAT in India handles pigeon pea, chickpea, and groundnut research. Both of these IARCs should be used to upgrade the grain legume research staff. The team recommends that training opportunity for two Kenyan researchers be sought in 1983, two in 1984, two in 1985, one in 1986, and one in 1987.

Potato Research Training

Table 61. Number of Training Grants Required for Potato Research Officers at the M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Replacement Staff	New Staff at B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	1	0	0	1	1	0	2	0
Agronomists	2	1	0	0	1	0	2	1
Entomologists	1	1	0	0	1	0	1	1
Pathologists	2	2	0	0	1	0	2	1
Economists	0	1	0	0	0	0	1	0
Food Science	1	0	0	0	0	0	0	0
Totals	7	5	0	1	4	0	8	3

* Includes all staff currently in training at the degree level they will achieve upon return.

The International Potato Center (CIP) in Peru conducts much of its training through regional outreach programs such as the office located at ILRAD in Nairobi. There are limited opportunities for research training at CIP headquarters in Lima which should be utilized if possible. Therefore, the following research training recommendations are made tentatively. The team feels that training at CIP should be sought for one Kenyan potato researcher in 1983, two in 1984, two in 1985, two in 1986, and one in 1987. In addition to these research training opportunities, the Kenya Potato Research Program should take advantage of additional CIP-sponsored research training that is offered in the region.

Roots and Tuber Research Training

In addition to the on-going potato research program, a major staff expansion is being recommended in the traditional root and tuber crops (cassava and yams), therefore, these training requirements are listed separately.

Table 62. Number of Training Grants Required for Roots and Tuber Research Officers at the M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Replacement Staff	New Staff at B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	0	0	0	0	0	4	2	0
Agronomists	1	0	0	0	0	3	3	0
Entomologists	0	0	0	0	0	2	1	0
Pathologists	0	0	0	0	0	2	1	0
Economists	0	0	0	0	0	1	1	0
Totals	1	0	0	0	0	12	8	0

* Includes all staff currently in training at the degree level they will achieve upon return.

IITA has an excellent roots and tuber research program. If this program is developed in Kenya (particularly in the coastal zone), the training resources at IITA should be fully exploited to get the national program moving as quickly as possible. The team recommends that training opportunity be sought at IITA for two Kenyan researchers for roots and tuber research training in 1983, two in 1984, three in 1985, two in 1986, and one in 1987.

Oil Seeds Research Training

Table 63. Number of Training Grants Required for Oil Seeds Research Officers at the M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Recruitment for Attrition	Net Additions B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	0	0	0	0	0	4	2	0
Agronomists	1	4	0	0	2	1	3	1
Entomologists	1	0	0	0	0	3	2	0
Pathologists	0	1	0	0	0	1	1	0
Totals	2	5	0	0	2	9	8	1

* Includes all staff currently in training at the degree level they will achieve upon return.

Since there are no IARCs dealing specifically with sunflower, rape seed, and sesame, there are no research short courses to take advantage of in this area at the present time. There is, however, a groundnut program team at ICRISAT that should be able to offer training assistance. Places should be sought for two agronomists in the next soybean production short course at the International Soybean Program (INTSOY) located at the University of Illinois.

Horticulture Research Training

Table 64. Number of Training Grants Required for Horticulture Research Officers at the M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Recruitment for Attrition	Net Additions B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	2	2	0	0	1	5	5	1
Agronomists	6	5	0	0	3	0	6	2
Entomologists	3	3	0	0	2	0	3	1
Pathologists	5	4	0	0	3	0	5	1
Economists	2	0	0	0	1	0	2	0
Soil Sc.	1	1	0	0	1	0	1	0
Others	5	0	0	1	2	0	3	0
Totals	24	15	0	1	13	5	25	5

The Asian Vegetable Research and Development Center (AVRDC) has good research training programs for horticulture researchers working on vegetable improvement. Researchers working in this area of the horticulture program should take advantage of these training opportunities. The team recommends that training opportunity be sought at AVRDC for two Kenyan horticulture researchers in 1983, two in 1984, two in 1985, two in 1986, and one in 1987.

Coffee Research Training

Table 65. Number of Training Grants Required for Coffee Research Officers at the M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Recruitment for Attrition	Net Additions B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	0	2	0	0	0	1	1	1
Agronomists	0	3	0	1	1	0	1	1
Entomologists	0	2	0	1	1	1	2	0
Pathologists	1	1	1	0	1	0	1	0
Economists	1	1	0	0	0	0	1	0
Others	1	1	0	0	0	0	0	0
Totals	3	10	1	2	3	2	6	2

* Includes all staff currently in training at the degree level they will achieve upon return.

Tea Research Training

Table 66. Number of Training Grants Required for Tea Research Officers at the M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Recruitment for Attrition	Net Additions B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	0	2	0	0	0	0	0	1
Agronomists	0	0	0	0	0	2	1	0
Entomologists	0	0	0	0	0	1	1	0
Pathologists	0	0	0	0	0	1	1	0
Economists	0	0	0	0	0	1	1	0
Soil & Water Conservation	0	0	1	0	0	1	1	0
Chemists	1	0	0	0	0	1	1	0
Totals	1	2	1	0	0	7	6	1

* Includes all staff currently in training at the degree level they will achieve upon return.

Pyrethrum Research Training

Table 67. Number of Training Grants Required for Pyrethrum Research Officers at M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Recruitment for Attrition	Net Additions B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	1	2	0	0	1	0	1	1
Agronomists	1	1	0	0	0	0	1	0
Entomologists	0	0	0	0	0	0	0	0
Pathologists	1	0	0	0	0	0	1	0
Economists	0	0	0	0	0	0	0	0
Others	0	1	0	0	0	0	0	0
Totals	3	4	0	0	1	0	3	1

Sugar Research Training

Table 68. Number of Training Grants Required for Sugar Research Officers at M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Recruitment for Attrition	Net Additions B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	2	0	0	0	0	0	2	0
Agronomists	2	1	0	0	1	0	2	1
Entomologists	0	0	0	0	0	+2	2	0
Pathologists	5	0	1	0	2	-2	3	0
Economists	2	0	0	0	0	0	2	0
Chemists	2	0	0	0	0	0	2	0
Processing	0	0	0	0	0	1	1	0
Soil sc.	0	1	0	0	0	0	0	0
Totals	13	2	1	0	3	1	14	1

* Includes all staff currently in training at the degree level they will achieve upon return.

Cotton Research Training

Table 69. Number of Training Grants Required for Cotton Research Officers at M.Sc. and Ph.D. Levels, 1983 to 1987.

	Current Staff by Qualification*				Recruitment for Attrition	Net Additions B.Sc. Level	Num. of Grants Required	
Discipline	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeders	4	2	0	0	2	0	4	1
Agronomists	3	3	0	0	2	0	3	1
Entomologists	2	4	0	0	2	-2	3	1
Pathologists	0	1	0	0	0	+2	2	0
Economists	0	0	0	0	0	1	1	0
Totals	9	10	0	0	6	1	13	3

* Includes all staff currently in training at the degree level they will achieve upon return.

Seed Quality Training

Table 70. Number of Training Grants Required for Seed Quality Research Officers, 1983 to 1987.

	Current Staff by Qualification*				Recruitment for Attrition	Net Additions B.Sc. Level	Num. of Grants Required	
Discipline	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeder	2	1	0	0	1	0	2	0
Agronomist	3	3	0	0	2	0	3	0
Entomologists	0	0	0	0	0	+3	2	0
Pathologist	2	1	0	0	1	0	2	0
Economists	1	1	0	0	0	0	1	0
Inspectors	3	0	0	0	1	0	0	0
Totals	11	6	0	0	5	+3	10	0

* Includes all staff currently in training at the degree level they will achieve upon return.

Training Requirements for Research Officers Not Assigned to Crop Improvement Programs

Given the recommended emphasis on commodity improvement and on-farm adaptive research, no specific additions to the stock of disciplinary-oriented research scientists in central specialized research services are proposed during the next five years. The disciplinary orientation of the 75 new additions is presented in Table 52 to indicate the fields of study being emphasized. Because at least 44% of the research staff in this category have two years or less experience, and 56% or more have only the B.Sc. degree, it is recommended that the major emphasis in the area of disciplinary research be on training and staff development, rather than staff expansion. It will take the next five years to train and effectively absorb these new entrants into disciplinary research activities.

Table 71: Number of Training Grants Required for Research Scientists Not Assigned to a Commodity Improvement Program.

	Current Staff by Qualification*				Replacement Staff	New Staff at B.Sc. Level	Num. of Grants Required	
Discipline	BSc	MSc	PhD	DK	BSc		MSc	PhD
Breeding	0	0	2	0	0	0	0	0
Agronomy	3	4	0	0	2	0	3	2
Soil & Plant Nutrition	15	10	0	2	8	0	15	3
Soil Physics	9	5	0	0	4	0	8	2
Entomology	15	9	1	0	8	0	15	3
Plant Pathology	8	5	1	0	4	0	8	2
Irrigation	12	5	0	0	5	0	11	2
Ag. Econ.	6	4	0	1	3	0	6	2
Other Agric	8	0	0	11	6	0	9	0
Totals	76	42	4	14	40	0	75	16

* Includes all staff currently in training at the degree level they will achieve upon return.

Other Research Training at IARCs

Several of the IARCs have research programs dealing directly or indirectly with farming systems research. For example, IITA deals with the humid tropics, while ICRISAT focuses on the semi-arid tropics. The International Center for Agricultural Research in Dry Areas (ICARDA) deals with production systems in more arid conditions, such as those

found in some areas of Kenya. The economics program at CIMMYT deals with economic factors as researchers attempt to develop technical recommendations that will be adapted by farmers. If Kenya moves forward to strengthen farming systems and/or on-farm adaptive research, then one or more of these research training programs might be used to begin upgrading the research staff involved in implementing these research programs.

Summary of Crops Research Training Requirements

Tables 72 and 73 summarize the recommended overall training requirements for crops research during the plan period (1983 through 1987). The sequencing of research officers undertaking formal degree courses would be more or less spread evenly over the five-year period, so that no commodity area would have more than 25% of its research staff out of the station for training at any one time.

Table 72. M.Sc. and Ph.D. Training Requirements for Crops Research Scientists, 1983 to 1987.

Commodity	Number of M.Sc.	Number of Ph.D.
Maize	29	4
Wheat and Barley	15	6
Sorghum and Millet	12	2
Rice	8	0
Grain Legumes	13	4
Potato	8	3
Roots and Tubers	8	0
Oil Seeds	9	1
Horticulture	25	5
Coffee	6	2
Tea	6	1
Pyrethrum	3	1
Sugar	14	1
Cotton	13	3
Seed Quality	10	0
Disciplinary Specific	75	16
Totals	254	49

Table 73: Overall Training Plan Showing the Approximate Number of Formal Degree and IARC Training Grants Required Each Year, 1983 to 1987.*

Type of Training	No. of Traineeships/Fellowships Required by Year					
	1983	1984	1985	1986	1987	Total
IARC Research Training	19	24	22	20	18	103
M.Sc. Grants (U.N.)	25	30	35	35	35	165
M.Sc. Fellowships (foreign)	24	20	15	15	15	89
Ph.D. Grants (U.N.)	1	2	2	2	2	9
Ph.D. Fellowships (foreign)	8	8	8	8	8	40
Totals	78	85	84	81	79	406

* Assumes that about two-thirds of M.Sc. training and one-fifth of Ph.D. training could be conducted at the Faculty of Agriculture, University of Nairobi by 1985. See following section on postgraduate training at the Faculty of Agriculture.

Postgraduate Training at The Faculty of Agriculture, University of Nairobi

As has been seen from Table 53, the output of M.Sc. agricultural graduates from the Faculty of Agriculture was very limited up until 1980. The March 1981 report of the University Grants Committee (UGC) (Chairman J. G. Kiano) clearly identified lack of funding as being the most critical constraint in the development of postgraduate programs at the University of Nairobi. The main reason for this is that since postgraduate courses have not been planned and coordinated at the government level, separate estimates of expenditure have never been established. Hence they have been funded from appropriations from the undergraduate per capitation fee. UGC also highlighted the importance of research undertaken by university staff members in the development of national technological capabilities and as a key aspect of postgraduate training programs. However, from 1977/78 to 1979/80 the University of Nairobi was only able to fund about 20% of research projects proposed by members of staff. Therefore, the recommendations of UGC that at least K£800 per annum should be set aside for each member of academic staff exclusively for research is strongly supported. Furthermore, with the creation of NCST, new resources have become available for faculty and postgraduate student research. This new mechanism for funding research should be encouraged and expanded.

The lack of funding for agricultural postgraduate training has meant that only approximately K£150 per annum has been available per student for research projects. Staff members have faced great difficulties in establishing their own research programs which could also provide the

basis for research projects for postgraduate students. And, as a result of inadequate training capacity, the M.Sc. plant breeding and plant pathology courses can only be run every other year. Only the M.Sc. agronomy and agricultural economics courses have a regular annual intake. The faculty has done its best in responding to the "crash" program for postgraduate training requested by the Ministry of Agriculture in 1978, as is evidenced by the outputs of over 30 M.Sc. graduates in 1980 and 1981. But it is clear that considerably more resources must be committed to agricultural postgraduate training as a matter of priority. Not only is the demand for such training very high from the agricultural research sector, but also from the faculty itself since only 36 of a total teaching establishment of 90 are Kenyan. And if a second faculty is established, another 60 teachers with M.Sc. and Ph.D. qualifications will have to be trained.

It is strongly recommended, therefore, that a detailed review of agricultural postgraduate training requirements in all sectors of the Kenyan agricultural economy be undertaken, and that the appropriate level of resources be committed to ensure their attainment. This review should also carefully evaluate the current organization of postgraduate training within the Faculty of Agriculture. If an expanded postgraduate program is to be pursued and new resources are to be allocated, then it is recommended that either a graduate college or faculty be established to administer these programs and maintain academic standards. It is beyond the scope of this report to consider this structural dimension further, but it appears that the faculty has reached the stage in its institutional development when its postgraduate programs need resources and a strong supporting structure to guide and facilitate further expansion.

There have been a number of other problems associated with M.Sc. agricultural courses at the University of Nairobi. Most M.Sc. students are sponsored by the Ministries of Agriculture and Livestock Development and attend the university as full-time students for one academic year, during which the great majority successfully complete the "theoretical" coursework instruction. The major difficulties arise in the second "practical" year of M.Sc. courses, when most students return to their research stations to undertake research projects which form the bases for their dissertations. It appears that many students quickly become involved in administrative and other research duties. Coupled with the acute difficulties of providing effective supervision when many stations are located so far from Nairobi, long delays (of up to five years in some cases) in the submission of dissertations result. While M.Sc. students should write their dissertations on topics which are of direct relevance to the priorities of their research stations, it is crucial that students receive proper supervision by experienced research scientists. This mentoring function is critical in the development of the young research scientist's technical/scientific skills and, equally important, his/her general attitudes and enthusiasm for agricultural research.

It is recommended, therefore, that in view of the present difficulties entailed in the completion of the "practical" M.Sc. work, that sufficient time and financial resources should be made available to M.Sc. and Ph.D. supervisors for them to make more regular trips to research stations and for students to return to the university for consultation. This would also serve to strengthen the weak links between the Faculty of Agriculture

and many of the research stations. Thus, not only will supervisors be able to assist their postgraduate students, but also to cooperate and collaborate with more experienced scientists at research stations on joint research projects, and to develop a better understanding of the types of research activities their students will be expected to pursue and the problems they will have to confront. This latter point is of particular importance in view of our recommendations concerning the need to place greater emphasis on applied and adaptive research in Kenya.

Strengthening the Faculty of Agriculture for Postgraduate Education

If it is accepted that agricultural research scientists should go for M.Sc. training after acquiring two to three years of on-the-job experience, it can be seen from Table 72 that the crops research system should attempt to train about 250 officers at the M.Sc. level over the next five years. If this training is spread out evenly over the period, annual demand will be in the region of 50 places per year for crops research alone. Under the Fifth IBRD Education Credit, a maximum annual output of 30 M.Sc. graduates from the Faculty of Agriculture (including forestry and animal production) is planned up until 1987. Given that agricultural research scientists only comprised 20% to 40% of the 1980 and 1981 M.Sc.s from the faculty, the projected output will be totally inadequate.

The very high demand for agricultural postgraduate training is also indicated by the fact that the projected number of trainees that the Ministry of Agriculture wanted to send overseas for M.Sc.s and Ph.D.s was 294 in 1980 to 1981 (as contrasted with our recommendation of 303 over the plan period), while only 40 students actually went. There appears to be a strong case, therefore, for an expansion of postgraduate training opportunities -- and this reinforces our general recommendation that the capacity of the Faculty of Agriculture to train postgraduate students should be expanded, as should the number of overseas scholarships. Core M.Sc. courses covering all the major disciplines should be programmed on a <u>regular</u>, <u>annual</u> basis so as to allow the major sponsor, most notably the Ministry of Agriculture, to formulate detailed training plans which will enable them to inform young research officers well in advance about when they will go for postgraduate training.

At the Ph.D. level only 9 out of a total of 385 Kenyan crops research graduates are known to have, or be studying for, a Ph.D. degree. At present there are only three to four part-time Ph.D. students at the University of Nairobi Faculty of Agriculture. Only two crop scientists are known to be studying for Ph.D.s at overseas universities.

We recommend, therefore, that the ministry and donors attach higher priority to Ph.D. training and, initially, that at least eight crop scientists with proven capabilities and a strong commitment to research be sent abroad annually for Ph.D. training as soon as possible. At the same time, however, we further recommend that the capacity of the Faculty of Agriculture for Ph.D.-level training also be expanded.

To expand the Ph.D.-level training capacity at the Faculty of Agriculture, it is recommended that over the next decade the University of Nairobi

formalize an institutional relationship with one or more foreign universities for cooperative degree programs. Under such an arrangement, Ph.D. students would take one or two years of course work at a foreign university, but would conduct their thesis research in Kenya and receive their degree from the University of Nairobi. Such an institutional arrangement might be part of a larger technical assistance program to strengthen the Faculty of Agriculture.

Improving the Linkage Between Research and Extension

The Ministry of Agriculture is planning a new national extension project, using the Training and Visit System (T & V) under World Bank support. Implementing an aggressive national extension program such as T & V raises important questions about the current availability of improved technology to be extended, the short- and long-term capacity of the agricultural research system to provide a continuing flow of new technology to extension, and the potential linkage problems between these two sets of institutions.

Based on preliminary findings in two districts (Nandi and Kericho), it has been concluded that some immediate progress can be made in increasing farm output by improving the cultural practices of farmers. However, these early successes have raised many additional research questions. The estimate of officials working with these pilot projects is that new technical recommendations must be forthcoming within three years if the national extension project is to maintain its initial momentum.

Given the relatively small number of experienced staff within the agricultural research system, the related problems of turnover and attrition, and the lack of any significant on-farm adaptive research, there are serious questions about the current ability of the agricultural research system to organize its resources to ensure a steady flow of new technology in the near future.

A related issue is the current level of involvement and linkage between research and extension, which is a serious institutional problem in most low-income countries, and which also appears to exist in Kenya. The key linkage personnel should be the research officers conducting on-farm adaptive research, and the subject matter specialists (SMSs) on the extension side. They must work closely together so research personnel will fully understand farmer problems and so SMSs will understand the new recommendations as they train and backstop field-level extension personnel through T & V.

An examination of manpower and training requirements for agricultural extension in Kenya is not within the terms of reference of this report, but if Kenya is typical of most countries, the lack of competent SMSs may be the weakest link in the T & V approach. Therefore, careful consideration must be given to how the skills and knowledge of SMSs will be upgraded. First, they must have a basic understanding of research and must be able to work effectively with researchers. At the same time, they must have the technical competence and communication skills necessary to demonstrate production practices and communicate technical recommendations to field extension personnel.

In order to integrate more effectively the adaptive research and SMS extension functions, it is recommended that a systematic, joint staff development program be implemented through the Faculty of Agriculture. Such a program could provide M.Sc.-level training for a combined group of agricultural research workers and SMSs from a specific agroclimatic zone, during a particular academic year. The purpose of this staff development program would be to simultaneously train these applied/adaptive research workers and SMSs as a functioning research-extension team. By training the group together, there would be some shared courses. Perhaps more important are the informal personal relationships which can result from this joint training. The results would be the beginnings of a team. Members would emerge as both colleagues and friends, and individuals from each field of study would better understand the role and responsibility of other members of the team. After finishing the nine months of course work, each M.Sc. student would undertake a thesis topic related to his/her job assignment within the research or extension system (i.e., SMSs might study either technical or extension problems). Periodic seminars every three months or so back on campus or at one of the main research stations or at an extension office would allow M.Sc. candidates to report on their progress, to learn about the findings of other students, and to further reinforce the functional integration of research and extension. The goal would be to create an esprit de corps and a common purpose, so that both research and extension would see their work as part of a continuum of developing and transferring improved technology to farmers.

A staff development program of this type would need to be carefully planned, and must consider current research staffing and activity, as well as the priority areas selected for initial inclusion in the national extension program. It is anticipated that if a group of 15 agricultural research workers and 10 SMSs from a major agroclimatic zone could initiate M.Sc. programs each year, some real progress could be made during the 1980s in upgrading key groups of research and extension workers, as well as in bridging the traditional gap between research and extension.

Implementing a major staff development effort of this type would require a major long-term effort to upgrade the capacity of the Faculty of Agriculture, particularly at the postgraduate level. First, on-campus technical assistance would be required to teach and supervise the additional M.Sc. students. Additional agricultural research personnel would be needed (sequenced over five years) in each major agroclimatic zone to initiate applied/adaptive research while students are taking their course work. Then during the second year these personnel would work with the students as they perform their thesis research. Finally, faculty development fellowships would be required to upgrade and expand the Faculty of Agriculture, so that these expanded postgraduate programs could be maintained after the end of the long-term technical assistance project.

Although most donor agencies operate on a funding cycle of four-to-five-year projects, a major program of this type should be planned on the assumption that there would be a minimum 10-year involvement by the donor and/or technical assistance agency. For example, this might be an excellent project for USAID to undertake through the Title XII mechanism. A U.S. university or consortium of universities could work directly with the Faculty of Agriculture and the agricultural research system to

increase the educational capacity of the faculty, while assisting the agricultural research (and extension) system to upgrade its staff to undertake applied/adaptive research.

Factors Affecting Postgraduate Education Overseas

The majority of Kenyan agricultural scientists with postgraduate training have received their education at overseas institutions. In part this has been due to the inadequacy of local postgraduate training capacity, but also reflects the need for Kenyan scientists to experience new intellectual and work environments.

In spite of the importance of overseas postgraduate training, up until the mid-1970s most donor-funded agricultural research projects had limited financial provision for the further training of Kenyan agricultural scientists. Since then, however, the Government of Kenya has been very successful in persuading donors to substantially increase the proportion of research project expenditure allocated to postgraduate training. This policy decision is very important and is wholeheartedly endorsed by this report. It is only by undertaking advanced training and through good working relationships with experienced local and expatriate scientists that a sufficiently large critical mass of Kenyan agricultural research scientists can be formed.

While there has been a substantial increase in postgraduate training overseas, the project-specific nature of most scholarships has some important negative side effects. First, while scientists at research stations with donor-funded projects have good training opportunities (see Table 74), the majority of research officers at stations which do not receive these levels of external assistance have few or no overseas training opportunities. Second, research officers are recruited and/or transferred to stations receiving donor support, either to meet counterpart requirements or to utilize training opportunities. While these manpower deployment practices are the result of administrative necessity, they can be highly detrimental to building strong research programs. We strongly recommend, therefore, that a more broad-based system-wide approach to training be pursued on the part of donors. Finally, these more narrow project approaches to training make it very difficult for the relevant ministries to formulate and implement medium-term training programs. There is clearly a need for greater flexibility and coordination in the allocation of training funds by donors, and it is strongly recommended that potential donors carefully review this system-wide analysis of manpower and training needs, and work closely with NCST to ensure that the overall agricultural research system is strengthened.

Table 74. Distribution of Crops Research Officers Undertaking Postgraduate Training from 1980 to mid-1982 by Crops Research Station.

Station		M.Sc.			Ph.D.		
National		Nairobi	Overseas	?	Nairobi	Overseas	?
ARD	Muguga	0	4	0	0	0	0
NARS	Kitale	0	0	0	0	0	0
NSRS	Kibos	0	0	0	0	0	0
NPBS	Njoro	3	8	0	0	2	0
NAL	Kabete	3	5	4	0	0	0
NHRS	Thika	2	0	1	0	0	0
NDLRS	Katumani	4	7	0	0	0	0
NPRS	Tigoni	0	0	0	0	0	0
NSQC	Lanet	0	5	1	0	0	0
Regions							
WARS	Kakamega	0	0	0	0	0	0
NARS	Kisii	1	0	0	0	0	0
PHRS	Molo	1	0	0	0	0	0
NARS	Ol Joro Orok	0	0	0	0	0	0
EARS	Embu	0	0	2	0	0	0
MTARS	Mwea Tebere	1	0	2	0	0	0
CARS	Mtwapa	0	0	0	0	0	0
CRS	Kibos	0	0	0	0	0	0
GRS	Garissa	0	0	0	0	0	0
		17	29	10	0	2	0

CHAPTER 9

MANPOWER ALLOCATIONS AND TRAINING REQUIREMENTS FOR ANIMAL PRODUCTION RESEARCH

Animal Production Research is currently organized around three major programs: (1) range management, (2) forage and pasture improvement, and (3) animal production. In terms of research priorities, a major effort is being made to increase beef production, particularly in the semi-arid and arid regions, through a range management program. However this is still in the early stages of both formulation and staff development.

Dairy production was traditionally concentrated in the high potential areas, but because of population pressure and more intensive land use, dairy production is being pushed into the medium- and even to the low-potential areas, although zero grazing (stall feeding) is also becoming increasingly common in the high-potential areas. In addition, a new research effort is underway to determine the potential for dairy goats among smallholders. Maintaining and expanding dairy production under rapidly changing conditions presents a challenge to dairy research scientists.

There is presently a major externally supported research program for small ruminants (sheep and goats), but again the research program is in the formative stages and a major expansion and improvement in staff development will be required to strengthen it.

The reassessment of research priorities and the organization of animal production research is currently being studied by the Animal Production Research Department of the Ministry of Livestock Development and the Animal Production Department at KARI. This study is urgently needed in order to clarify research priorities and organizational issues. But since it is not completed, it was not possible to utilize its findings in determining manpower allocations for animal production research. The following analysis and recommendations should therefore be considered as tentative and subject to modification when the broader study has been completed and approved.

Current Stocks and Recommended Allocations of Animal Production Research Officers

As indicated in Chapter 5, it is proposed that animal production research receive a net addition of 11 new research staff members per year over the plan period (1983 to 1987). The analysis of the current research staff has been undertaken at two levels. In the case of the individual livestock areas, the analysis will be by area and by discipline. In the case of range management and forage and pasture management, since these areas are essentially fields of study or disciplines, no further breakdown is possible. Therefore, the first set of tables are presented by discipline and include the animal science research officers. However, the recommended allocations within animal production research have been further broken down in the subsequent tables where each animal area is treated individually.

Many of the general comments and notes on tables in the crops research section also apply to this section; for example ( ) means the total number of staff including expatriates.

Table 75. Number of Animal Production Research Officers by Discipline, 1982.

	Formal Qualifications						Years Work Experience					
Discipline	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeding and Genetics	5(6)	0	3	2	0	0	2	0	0	1	1	1
Animal Nutrition	11(12)	1	3	7	0	0	3	3	2	1	1	1
Production & Management	11(11)	2	3	5	0	1	3	2	0	3	3	0
Reproductive Physiology	2(2)	0	1	0	0	1	0	1	0	1	0	0
Forage and Pasture Improvement	22(25)	4	6	11	0	1	7	3	2	5	3	2
Range Management	8(13)	3	1	3	0	1	3	1	0	2	0	2
Others (incl. Admin.)	6(7)	0	2	4	0	0	3	1	0	1	1	0
Totals	65(75)	10	19	32	0	4	21	11	4	14	9	6

Table 76. Recommended Net Increases of Animal Production Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982 Exp.[1]	Inexp.[2]	Research personnel to be added from 1983 to 1987 1983	1984	1985	1986	1987	Total
Breeding and Genetics	2	3	*	*	*	*	*	*
Animal Nutrition	4	7	*	*	*	*	*	*
Production & Management	5	6	*	*	*	*	*	*
Productive Physiology	0	2	*	*	*	*	*	*
Forage and Pasture Improvement	10	12	0	0	0	0	0	0
Range Management	2	6	3	3	3	3	2	14
Others (incl. Adm.)	2	4	0	0	0	0	0	0
Totals	25	40	3	3	3	3	2	14

* Note: Recommended staff additions for these disciplines will be allocated in subsequent tables by specific livestock area (i.e., beef, dairy, etc.)

1 Exp. = An experienced research officer is defined as having at least an M.Sc. degree and five or more years of experience.

2 Inexp. = An inexperienced research officer is defined as having a B.Sc degree and/or less than five years of experience.

Given the relatively strong forage and pasture improvement program currently in place, it is recommended that range management be further expanded due to the increasing need to exploit the low potential areas of the country for expanded meat production. This expanded research work should be carried out in close cooperation with those livestock research officers who are working on ruminant (large and small) production programs.

Table 77. Number of Beef Research Officers by Discipline, 1982.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeding and Genetics	1(1)	0	1	0	0	0	1	0	0	0	0	0
Animal Nutrition	1(1)	0	0	1	0	0	0	1	0	0	0	0
Production & Management	1(1)	0	0	0	0	1	0	0	0	1	0	0
Reproductive Physiology	1(1)	0	0	0	0	1	0	0	0	0	1	0
Forage and Pasture Improvement	2(2)	1	0	0	0	1	0	1	0	0	0	1
Range Management	1(1)	0	1	0	0	0	1	0	0	0	0	0
Totals	7(7)	1	2	1	0	3	2	2	0	1	1	1

Table 78. Recommended Net Increases of Beef Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeding and Genetics	0	1	1	1	1	0	1	4
Animal Nutrition	0	1	0	1	0	1	0	2
Production & Management	0	1	1	1	1	2	1	6
Reproductive Physiology	0	1	0	0	0	0	0	0
Forage and Pasture Improvement	0	2	*	*	*	*	*	*
Range Management	0	1	*	*	*	*	*	*
Other								
Totals	0	7	2	3	2	3	2	12

*Note: Recommended staff increases for these disciplines are included in Table 76.

Beef research in the past has primarily concentrated on the medium-potential areas of the highlands. This effort should be continued at the established levels, and the additional research officers should be assigned to research stations in the low-potential areas (particularly along the coast) to work in close conjunction with the range management research officers.

Table 79. Number of Dairy Research Officers by Discipline, 1982.

Discipline	Formal Qualifications						Years Work Experience					
	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeding and Genetics	4(4)	0	2	2	0	0	1	0	0	1	1	1
Animal Nutrition	5(5)	0	2	3	0	0	1	1	1	1	1	0
Production & Management	5(5)	0	1	4	0	0	2	2	0	0	1	0
Reproductive Physiology	0(0)	0	0	0	0	0	0	0	0	0	0	0
Other - not specified	1(1)	0	1	0	0	0	0	1	0	0	0	0
Totals	15(15)	0	6	9	0	0	4	4	1	2	3	1

Table 80. Recommended Net Increases of Dairy Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeding and Genetics	2	2	0	0	1	0	0	1
Animal Nutrition	3	2	0	1	0	0	0	1
Production & Management	1	4	1	0	1	1	1	4
Reproductive Physiology	0	0	1	0	0	0	0	1
Other	1	0	0	0	0	0	0	0
Totals	7	8	2	1	2	1	1	7

The new staff additions in dairy research should focus on two main areas. First an effort should be made to increase dairy production among smallholders in the high- and medium-potential areas by (1) working with the pasture research workers to maximize forage output per unit of land and (2) to develop production and management practices appropriate for zero-grazing production systems. Second, as dairying is forced into the medium- and low-potential areas, this will require a comprehensive research effort in breeding, management, and nutrition (using dual-purpose animals) to develop production systems for these poorer areas.

Table 81. Number of Sheep and Goat Research Officers by Discipline, 1982.

	Formal Qualifications						Years Work Experience					
Discipline	Total	B/Gn	B/Ag	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Breeding and Genetics	0(0)	0	0	0	0	0	0	0	0	0	0	0
Animal Nutrition	1(1)	0	0	1	0	0	1	0	0	0	0	0
Production & Management	2(2)	1	1	0	0	0	0	0	0	1	1	0
Reproductive Physiology	1(1)	0	1	0	0	0	0	1	0	0	0	0
Forage and Pasture Improvement	1(1)	0	1	0	0	0	1	0	0	0	0	0
Range Management	0(0)	0	0	0	0	0	0	0	0	0	0	0
Animal Diseases	2(2)	2	0	0	0	0	2	0	0	0	0	0
Other - Not Specified	1(1)	1	0	0	0	0	0	0	0	0	0	1
Totals	8(8)	4	3	1	0	0	4	1	0	1	1	1

Table 82. Recommended Net Increases of Sheep and Goat Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Breeding and Genetics	0	0	1	0	1	0	0	2
Animal Nutrition	0	1	0	1	0	0	0	1
Production & Management	0	2	1	1	1	0	1	4
Reproductive Physiology	0	1	0	0	0	0	0	0
Forage and Pasture Improvement	0	1	*	*	*	*	*	*
Animal Diseases	0	2	0	0	0	0	0	0
Other	0	1	0	0	0	0	0	0
Totals	0	8	2	2	2	0	1	7

*Note: Recommended staff increases for this discipline is included in Table 76.

There is a major externally funded project on small ruminants. It appears essential to allocate additional research staff to this important area of sheep and goat production. The current staff is quite inexperienced, therefore a major training effort is required. However, during this time some additional staff should be added to maintain the research program while the current staff are on study leave, and to gradually build up the strength of this research program.

Table 83. Number of Poultry Research Officers by Discipline, 1982.

Discipline	Total	Formal Qualifications B/Gn	B/Ag	MSc	PhD	Dk	Years Work Experience 0-2	3-4	5-6	7-10	10+	Dk
Breeding and Genetics	0(0)	0	0	0	0	0	0	0	0	0	0	0
Animal Nutrition	0(0)	0	0	0	0	0	0	0	0	0	0	0
Production & Management	2(2)	1	0	1	0	0	0	0	0	0	2	0
Totals	2(2)	1	0	1	0	0	0	0	0	0	2	0

Table 84. Recommended Net Increases of Poultry Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982 Exp.	Inexp.	Research Personnel To Be Added from 1983 to 1987 1983	1984	1985	1986	1987	Total
Breeding and Genetics	0	0	1	0	0	1	0	2
Animal Nutrition	0	0	0	1	0	0	1	2
Production & Management	1	1	0	1	1	0	1	3
Totals	1	1	1	2	1	1	2	7

Poultry research is weak in Kenya and needs to be strengthened. While urban areas are relatively well served by major poultry production units, using modern technology, it is recommended that an expanded research program be directed at poultry production among smallholders.

Other Research Areas

Currently there are no research officers working on swine, rabbits, camels, and bees. It is recommended that small research programs be initiated and that research officers be added in the following areas to develop expertise and to maintain contacts with advances in world research for opportunities in these areas.

Table 85. Recommended Net Increases of Other Research Officers by Livestock Area and Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
	Exp.	Inexp.	1983	1984	1985	1986	1987	Total
Swine Breeding	0	0	0	0	0	1	0	1
Swine Prod. & Management	0	0	1	0	0	1	1	3
Rabbit Prod.	0	0	0	0	0	1	1	2
Camel Prod.	0	0	0	0	0	0	1	1
Beekeeping	0	0	0	1	0	0	0	1
Totals	0	0	1	1	0	3	3	8

Summary of Manpower Allocation in Animal Research Production

We recommend a proportionally large expansion in the animal production research area. We further recommend that the majority of additions should be in the breeding, nutrition, production, and management of the different types of livestock that are important in Kenya, particularly those animals and products that are produced by smallholders both for home consumption and for sale. The following table summarizes how the net addition of 55 research officers should be allocated between livestock areas and disciplines. Implementing these recommendations would expand the size of the animal production research system to 120 research officers by the end of 1987.

Table 86. Summary of Current Staff by Livestock Area and/or Discipline, Recommended Net Increases, 1983 to 1987, and Projected Staff Size in 1982.

Livestock Area and/or Discipline	No. of Research Officers (1982)	Net Additions (1983-87)	Expected No. of Research Officers in 1987
Range Management	8	14	22
Forages and Pastures	22	0	22
Beef Breeding	1	4	5
Beef Nutrition	1	2	3
Beef Prod. & Mgt.	1	6	7
Dairy Breeding	4	1	5
Dairy Nutrition	5	1	6
Dairy Prod. & Mgt.	5	4	9
Small Ruminant Breeding	0	2	2
Small Ruminant Nutrition	1	1	2
Small Ruminant Prod. & Mgt.	2	4	6
Repro. Physiology	2	1	3
Poultry Breeding	0	2	2
Poultry Nutrition	0	2	2
Poultry Prod. & Mgt.	2	3	5
Swine Breeding	0	1	1
Swine Prod. & Mgt.	0	3	3
Rabbit Production	0	2	2
Camel Prod./Traction	0	1	1
Beekeeping	0	1	1
Other (incl. Admin.)	11	0	11
Totals	65	55	120

The Supply of Animal Production Research Officers

There are two departments in the Faculty of Agriculture concerned with animal production training. The Department of Animal Production is a constituent department of the Faculty of Agriculture, but also serves the Faculty of Veterinary Medicine. The department offers courses to first- and second-year B.Sc. (agriculture) and B.Sc. (range management) students, as well as first-year food science and technology students. The Department of Range Management was established in 1981 and offers a separate B.Sc. program in range management. At present the intake is about 15 students, but the department is to be expanded considerably under the provisions of the Fifth IBRD Education Credit. Projected enrollments are presented in Table 87. With a projected output of 65 to 70 Kenyan B.Sc. (range management) graduates, it is likely that the 14 or 15 additional research scientists required for range research can be recruited from this source.

Table 87. Projected Outputs of Graduates from the Department of Range Management, University of Nairobi, 1980/81 to 1998/90.

Year	80/81	81/82	82/83	83/84	84/85	85/86	85/87	87/88	88/89	89/90
1	20	20	20	30	30	30	30	40	40	40
2	-	20	20	20	30	30	30	30	40	40
3	-	-	20	20	20	30	30	30	30	40

Source: IBRD, Report on the Fifth Education Credit to Kenya.

There are more serious problems to be confronted in building a strong animal production research program. As pointed out by the Committee on Maize and Pasture Research, "there is a very strong bias against animal production careers by graduates." This view was endorsed by the Dean of the Faculty of Agriculture and the Director and Deputy Directors of Livestock Research. Part of the problem stems from the fact that animal production courses are a relatively small component of a wide-ranging B.Sc. (agriculture) program; this lack of emphasis in the curriculum fails to attract sufficient graduates into animal production careers. To remedy this situation, the University of Nairobi, in collaboration with the Ministry of Livestock Development, has submitted a funding proposal for the introduction of a separate B.Sc. program in animal production in the Faculty of Veterinary Medicine at a total capital cost of K£1.3 million. This is intended to provide teaching and accommodation facilities for an additional 50 students. The ministry's objective is to attain a B.Sc. (animal production) output of 50 per year. In accordance with the need to place greater emphasis on animal production research, we recommend that the current proposals for the introduction of the B.Sc. (animal production) degree should be accepted and implemented as soon as possible. In addition, a detailed assessment of manpower requirements for animal production and range management officers in both extension and

research activities should be undertaken so that a more comprehensive and complete manpower and training plan can be formulated.

It is now unlikely that the B.Sc. (animal production) course can be started before 1984, so the first output of students will not be until 1986. In the meantime, the research division of the Ministry of Livestock Development will have to continue to rely upon B.Sc. (agriculture) and B.Sc. (science) graduates in order to achieve the constrained demand recruitment target of approximately 55 animal production scientists between 1983 and 1987.

Postgraduate Training Requirements for Animal Production Research Officers

The primary type of training being recommended for animal production research officers is formal postgraduate degree programs. Table 88 summarizes the current degree level of existing officers, anticipates the likely level of replacements that will be needed for normal attrition (estimated at about 6% per year) during 1983 to 1987, and includes the net additions of research officers by livestock area and discipline. Since the overall goal is to raise the minimum educational level of officers to the M.Sc level, considerable emphasis has been placed on this type of training. However, in determining the number of people to be trained, account must be taken of the fact that some officers may not be qualified (either for age or academic reasons) and/or will not be ready to begin M.Sc training during the plan period (i.e., those hired during 1987). Obviously such a plan needs to be carefully implemented, using the specific criteria discussed in Chapter 7 for selecting officers for training and sequencing the training so the on-going research program does not suffer.

The Department of Animal Production has run an M.Sc. course in animal production since 1977, but numbers remain small -- only five Kenyans in 1981 and four in 1982. As with the Department of Forestry proposal, the IBRD Fifth Education Credit report does not specify any student projections at the M.Sc. level and above. In contrast, the projected number of trainees estimated by the Ministry of Livestock Development for 1980 to 1981 to require M.Sc. training at the University of Nairobi was 51, of whom only 3 were actually sent.

From Table 88 it can be observed that the average output of animal production and range management M.Sc. graduates for the research system alone will have to be, on average, approximately 11 per annum if the constrained demand training requirements are to be met. It is essential, therefore, that the M.Sc. program in animal production at the University of Nairobi be strengthened in order to ensure that sufficient postgraduates are produced. Similarly, the probable size of the postgraduate program in the Department of Range Management needs to be clarified and, if necessary, additional resources should be procured. It is likely, however, that given the recent establishment of the department, it will not be in a position to train the numbers of M.Sc. graduates required, and continued reliance will have to be placed on overseas postgraduate training programs.

Table 88. Number of Training Grants Required for Animal Production Research Officers at M.Sc. and Ph.D. Levels, 1983 to 1987.

Livestock Area and/or Discipline	Current Staff by Qualification*				Recruitment for Attrition	Net Additions at B.Sc. Level	Number of Grants Required	
	BSc	MSc	Ph	?	BSc		MSc	PhD
Range Management	4	3	0	1	4	14	10	2
Forages and Pastures	10	11	0	1	7	0	10	5
Beef Breeding	1	0	0	0	1	4	3	0
Beef Nutrition	0	1	0	0	0	2	1	1
Beef Prod. & Mgt.	0	0	0	1	1	6	3	0
Dairy Breeding	2	2	0	0	1	1	2	1
Dairy Nutrition	2	3	0	0	2	1	2	2
Dairy Prod. & Mgt.	1	4	0	0	2	4	3	2
Small Ruminant Breedg.	0	0	0	0	0	2	1	0
Small Ruminant Nutrition	0	1	0	0	0	1	1	1
Small Ruminant Prod. & Mgt.	2	0	0	0	1	4	4	0
Repro. Physiology	2	0	0	0	1	1	2	1
Poultry Breeding	0	0	0	0	0	2	1	0
Poultry Nutrition	0	0	0	0	0	2	1	0
Poultry Prod. & Mgt.	1	1	0	0	1	3	2	1
Swine Breeding	0	0	0	0	0	1	1	0
Swine Prod. & Mgt.	0	0	0	0	0	3	2	0
Rabbit Production	0	0	0	0	0	2	1	0
Camel Prod./Traction	0	0	0	0	0	1	1	0
Beekeeping	0	0	0	0	0	1	0	0
Others (incl. Admin)	4	6	0	1	4	0	4	2
Totals	29	32	0	4	25	55	55	18

* Includes all staff currently in training at the degree level they will achieve upon return.

Ph.D. Training Requirements

At present there are only three Kenyan animal production scientists who are acquiring Ph.D. degrees. Since each program area should have at least one research officer with doctoral-level training as soon as possible, there is an urgent need for a relatively sizeable increase in Ph.D. training for animal production research. We recommend, therefore, that approximately 18 M.Sc.-holders of proven competence and motivation should be sent for Ph.D. training between 1983 and 1987 (i.e., an average intake of three or four per year).

CHAPTER 10

MANPOWER ALLOCATIONS AND TRAINING REQUIREMENTS FOR VETERINARY RESEARCH

Veterinary research in Kenya dates from 1908 when the Veterinary Research Laboratory (VRL) was established at Kabete, to diagnose livestock diseases and to develop vaccines to combat them. More recently the Veterinary Research Department at KARI was established to take over some of the research program previously carried by the East African Veterinary Research Organization on diseases common to all East African countries and some aspects of more basic research work requiring special facilities; nearly one-third of the established posts are at Muguga.

In discussing the allocation of resources between the various sectors of the overall agricultural research system, there was a general consensus that veterinary research had the necessary critical mass of research officers to build a strong research program. However, the immediate problem is that the staff is relatively young and inexperienced, and generally in need of more training both through good supervision on the job and in formal degree programs. Therefore, only modest increases in staff size (two additional officers per year) are recommended during the plan period (1983 to 1987), with most effort being placed on training and staff development.

Current Stocks and Recommended Allocations of Veterinary Research Officers

In Table 89 the staffing pattern, qualifications, and experience profile of the current research staff are presented. Then in Table 90, the recommended net additions to the research staff are indicated, with the allocation proposed under conditions of constrained demand.

Table 89. Number of Veterinary Research Officers by Discipline, 1982.

		Highest Qualification					Work Experience					
Discipline	Total	B/Gn	BVM	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Bacteriology	17(18)	2	4	9	1	1	9	2	0	1	0	5
Biochemistry	4(5)	1	1	2	0	0	3	0	0	0	0	1
Helminthology	9(9)	1	1	6	1	0	6	1	0	0	0	2
Pathology	8(8)	0	1	6	0	1	2	2	0	1	1	2
Protozoology	9(10)	0	2	6	0	1	3	1	1	0	0	4
Immunology	4(5)	0	2	1	0	1	1	0	1	0	0	2
Virology	6(9)	1	0	5	0	0	0	1	0	0	0	5
Wildlife	4(4)	0	4	0	0	0	4	0	0	0	0	0
Other veterinary (inc. VILs)*	37(51)	4	14	15	1	3	20	4	1	3	0	9
Totals	98(119)	9	29	50	3	7	48	11	3	5	1	30

* VILs = Veterinary Inspection Laboratories.

Table 90. Recommended Net Increases of Veterinary Research Officers by Discipline, 1983 to 1987.

Discipline	Current Stocks in 1982	Research Personnel To Be Added from 1983 to 1987					
		1983	1984	1985	1986	1987	Total
Bacteriology	17	0	0	0	0	0	0
Biochemistry	4	0	0	0	0	0	0
Helminthology	9	0	0	0	0	0	0
Pathology	8	0	1	0	1	0	2
Protozoology	9	0	0	0	0	0	0
Immunology	4	1	0	1	0	1	3
Virology	6	1	1	1	1	1	5
Wildlife	4	0	0	0	0	0	0
Other (incl. VILs)	37	0	0	0	0	0	0
	98	2	2	2	2	2	10

The Supply of Veterinary Research Officers

The Faculty of Veterinary Medicine at the University of Nairobi was established as a degree-granting faculty in July 1962. Up until the mid-1970s it also trained veterinary undergraduates from Tanzania and Uganda, and approximately half of the output from the faculty was comprised of students from these two countries. However, with the establishment of the University of Nairobi in 1970 and the dismantlement of the East African Community after 1976/77, the number of foreign undergraduate students dwindled to only 3 out of a total intake of nearly 90 in 1981.

The Faculty of Veterinary Medicine has a total academic staff establishment of 96, but at present there are only 52 Kenyans and 18 expatriates in post. This shortage of teaching staff, coupled with increasingly serious funding problems, has reduced the average amount of time spent on research by each staff member to 20% instead of the prescribed level of 40%.

Past and projected outputs of BVM graduates were presented in Table 53 on page 89. The establishment of another faculty of veterinary medicine has been recommended by the Second University Commission, with a proposed enrollment of 320 students and 24 teaching staff, but it is unlikely that any graduates will be produced before 1990. The Dean of the Faculty of Veterinary Medicine indicated that veterinary research is not a very popular career choice among BVM graduates (mainly because it would appear that veterinary officers in extension have considerable opportunities to earn a secondary income from private practice) and at present only between 10% and 15% of them are entering research. However, since it is recommended that the current stock of veterinary research scientists

should be stabilized during the next five years (i.e., only filling serious gaps), there should be sufficient BVM graduates available to compensate for attrition and the small annual increases.

Postgraduate Training Requirements for Veterinary Research Officers

Although it is recommended that there be only slight increases in the veterinary research sector between 1983 and 1987 (in terms of the total number of scientists employed), there is still a major task of upgrading the existing stock of BVM and M.Sc. graduates. In total, some 50 veterinary research officers should be available to complete M.Sc. courses to achieve the objective of nearly all graduates pursuing postgraduate training after two or three years of employment (see Table 91).

Table 91. Postgraduate Training Requirements for Veterinary Research Officers at M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification*				Replacement Staff at B.Sc. Level	New Staff at B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK			MSc	PhD
Bacteriology	6	9	1	1	5	0	7	2
Biochemistry	2	2	0	0	1	3	4	1
Helminthology	2	6	1	0	3	0	3	2
Pathology	1	6	0	1	2	2	3	2
Protozoology	2	6	0	1	3	0	3	2
Immunology	2	1	0	1	1	2	3	0
Virology	1	5	0	0	2	3	4	2
Wildlife	4	0	0	0	1	0	3	0
Other (incl. VILs)	18	15	1	3	11	0	20	1
Totals	38	50	3	7	29	10	50	12

* Includes all staff currently in training at the degree level they will achieve upon return.

Veterinary postgraduate training was introduced in the early 1970s, but as can be seen from Table 53 total outputs of M.Sc. and Ph.D. graduates have been only 28 and 11, respectively, and approximately half of these have been foreign students. Initially it had been hoped that postgraduate enrollments would be equal to approximately 10% of undergraduate enrollments, but this has been impossible to achieve given shortages of teaching staff and funding for postgraduate and general research programs. The dean estimates that the faculty's capacity for

postgraduate training needs to be doubled if the requirements of the research and higher education sectors are to be met. The study team fully endorses this view and recommends that a detailed assessment of the capital and recurrent expenditures required to attain the necessary postgraduate training targets be undertaken as soon as possible.

Fortunately, the two main veterinary research laboratories in Kenya have been relatively successful in obtaining overseas scholarships for their young graduates. Approximately 45 of the 99 veterinary research officers in post in 1982 had undertaken a postgraduate training course during the previous three years or were currently completing one -- all but one of them at the M.Sc. level. This level of support should be maintained in the future if the M.Sc. requirement for veterinary research is to be met.

Ph.D. Training Requirements

The Veterinary Research Division in the Ministry of Livestock Development and at KARI recognize the need for Ph.D. training for veterinary scientists, but they have been reluctant to lose eligible candidates for the three-or-four-year training period since they are the most senior scientists and cannot easily be spared.

However, in the next year or two, there should be sufficient numbers of M.Sc.-holders within the system to select a relatively small number of highly able and motivated Ph.D. candidates (probably no more than two or three a year) to undertake research in specialized areas which are of direct relevance to ongoing research programs. The recommended numbers of Ph.D. trainees by discipline for 1983 to 1987 are presented in Table 91. Ideally, these Ph.D. students should be registered locally at the Faculty of Veterinary Medicine. At present, however, only 1 of the 12 Ph.D. students is from a veterinary research laboratory. It is recommended, therefore, that much greater use should be made of the excellent facilities at the Faculty of Veterinary Medicine, particularly in cooperation with other research institutions in the area (discussed below).

Strengthening the Faculty of Veterinary Medicine

In recent years, with the transition of the Faculty of Veterinary Medicine from a regional to a national training institution, and the establishment of new international, regional, and national programs in Kenya dealing with animal diseases, external assistance to the faculty has steadily declined. This decline has constrained the faculty's capacity to provide postgraduate education. Given the importance of strengthening postgraduate veterinary training, external assistance should continue.

The postgraduate capacity of the Faculty of Veterinary Medicine could be considerably enhanced if the relationship between the faculty and the veterinary research institutions (such as KARI, VRL, and ILRAD) was strengthened. Some collaborative work between these institutions is already underway, particularly in research. The recent establishment of the Nairobi Cluster (a collaboration between institutions concerned with veterinary research) demonstrates that the environment for more formal cooperation exists. It is recommended that this same spirit of

cooperation be formally extended into the area of postgraduate education and training. Such an arrangement could help the faculty to improve its programs, while enabling international research institutions such as ILRAD to continue strengthening Kenya's national and regional capacity for animal disease research.

For example, while 10 Kenyans were receiving postgraduate training at ILRAD in 1982, only 4 were registered at the University of Nairobi. The remainder were registered at foreign universities overseas. Furthermore, those staff members who were employed at the Veterinary Research Laboratory (VRL) were pursuing M.Sc. rather than Ph.D. degrees. The Kenyan Ph.D. candidates at ILRAD were not institutionally affiliated with either VRL or KARI, therefore, it is uncertain if these more highly trained Kenyans will actually join and strengthen these national research institutions when they complete their training. In summary, there is a need for more systematic planning and coordination between the faculty and the national and international veterinary research institutions to better exploit postgraduate training opportunities. Resources at the faculty, ILRAD, and the other research institutions are finite and must be put to greatest use in strengthening the national research capacity for veterinary research.

CHAPTER 11

MANPOWER ALLOCATIONS AND TRAINING REQUIREMENTS FOR FORESTRY RESEARCH CENTER

A careful analysis of program priorities and organizational requirements for forestry research in Kenya during the 1980s has been undertaken by Dr. J. Odera, Director of the Forestry Research Department at KARI. While the manpower allocations and training requirements recommended in the Odera report have had to be scaled down in accordance with the constrained demand methodology adopted in this study, the substance and form of Dr. Odera's manpower and training priorities for particular types of forestry research have not been significantly altered.

Current Stocks and Recommended Allocations of Forestry Research Offices

As indicated earlier, the increasing demand for forest products and services from a very limited forest area has intensified the need for a substantially expanded forestry research program so that Kenya's forestry resources can both be effectively utilized today and expanded (through reforestration programs, etc.) for future use. To date, forestry research has been severely constrained due to the lack of manpower and

Table 92. Number of Forestry Research Officers by Discipline, 1982.

		Highest Qualification					Work Experience					
Discipline	Total	B/Gn	BSc/F	MSc	PhD	Dk	0-2	3-4	5-6	7-10	10+	Dk
Silviculture	5(5)	0	2	2	1	0	0	0	0	3	0	2
Dryland Afforestation	3(3)	0	2	1	0	0	1	0	0	0	0	2
Forest Mensuration	1(1)	0	0	1	0	0	0	1	0	0	0	0
Forest Products Res.	2(2)	1	0	1	0	0	0	0	0	0	0	2
Entomology and Zoology	2(2)	0	1	1	0	0	1	0	1	0	0	0
Forest Pathology	3(3)	1	1	0	1	0	0	0	0	0	1	2
Forest Fires Research	0(0)	0	0	0	0	0	0	0	0	0	0	0
Seed Research	1(1)	0	1	0	0	0	0	1	0	0	0	0
Other Forestry	1(1)	0	0	1	0	0	1	0	0	0	0	0
Totals	18(18)	2	7	7	2	0	3	2	1	3	1	8

related research resources. Therefore, over the next five years it is recommended that an additional 10 research officers be added each year, bringing the total research staff up to 68.

To determine how these new research officers will be allocated by program area, it is first necessary to review the current staffing situation as presented in Table 92. The overall net increase in forestry staff is subsequently allocated and sequenced in Table 93 in accordance with Dr. Odera's recommendations.

Table 93. Recommended Net Increases in Forestry Research Scientists by Discipline, 1983 to 1987.

	Current Stocks in 1982		Research Personnel To Be Added from 1983 to 1987					
Discipline	Exp	Inexp	1983	1984	1985	1986	1987	Total
Silviculture	3	2	2	3	2	3	2	12
Dryland Afforestation	2	1	2	2	2	2	2	10
Community Forestry	0	0	1	1	1	1	1	5
Forest Mensuration	0	1	1	1	1	1	1	5
Forest Products Research	1	1	1	1	2	1	2	7
Entomology & Zoology	1	1	1	1	0	1	1	4
Forest Pathology	1	2	1	0	0	1	1	3
Forest Fires Res.	0	0	0	1	1	0	0	2
Seeds Research	0	1	0	0	0	0	0	0
Other Forestry	0	1	0	0	0	0	0	0
Totals	8	10	10	10	10	10	10	50

The Supply of Forestry Research Officers

Up until 1978 undergraduate forestry was studied at overseas institutions, mainly in the United Kingdom and at the University of Dar-es-Salaam, Tanzania. It is estimated that approximately 150 Kenyans have received forestry degrees and returned to take up productive employment in Kenya -- mostly as managers in the Ministry of Environment and National Resources. There are only 10 M.Sc. and 3 Ph.D. (forestry) degree-holders in the country.

The Department of Forestry is part of the Faculty of Agriculture and is situated at the Kabete campus. The first output of 8 students was in

1980, followed by another 13 in 1981. The department is, however, to receive substantial assistance as part of the Fifth IBRD Education Credit, and outputs are planned to increase to 25 in 1984 and 1985, and 30 in 1986 and 1987 (see Table 94). At present, the department is staffed by three Kenyans and one Finn (shortly to be increased to three). Staff requirements for 1984 and 1985 are estimated to be 16. Two additional experts will be provided as part of the IBRD Education Credit.

Out of a total projected output of 146 forestry graduates between 1983 and 1987, the head of the department and also the Ministry of Environmental and Natural Resources, estimate that probably no more than 20% will find their way into forestry research. Given the projected requirement of 50 forestry research scientists during this period, it is apparent that only 50% of these scientists will likely be recruited from Department of Forestry graduates. It may be necessary, therefore, to recruit a sizeable number of B.Sc. (science) graduates into forestry research, which poses the same problems concerning their suitability as in the crops research sector, and the need for postgraduate training in forestry.

Postgraduate Training Requirements for Forestry Research Officers

Since there are currently no IARCs for forestry research, the training plan presented here concentrates on formal degree courses (although some valuable short course experience might be possible at ICRAF in due course). Also, since forestry research has been severely understaffed in the past, the major emphasis during the plan period (1983 to 1987) will be on expanding forestry research manpower. Therefore, since it is recommended that 10 research officers be added each year and that as a general policy they should work for at least one year before beginning M.Sc. training, this will result in proportionately fewer training grants being required during the coming five-year period. The demand for postgraduate forestry training is expected to grow steadily, therefore, postgraduate training at the University of Nairobi will also need to be strengthened (discussed below). Postgraduate training requirements for forestry research officers during 1983 to 1987 are presented in Table 95.

Table 94. Projected Outputs of Graduates from the Department of Forestry, University of Nairobi, 1980/81 to 1998/90.

Year	80/81	81/82	82/83	83/84	84/85	85/86	85/87	87/88	88/89	89/90
1	25	25	30	30	40	40	40	40	40	40
2	-	25	25	30	30	40	40	40	40	40
3	-	-	25	25	30	30	40	40	40	40

Source: IBRD, Report on the Fifth Education Credit to Kenya.

Table 95. Number of Training Grants Required for Forestry Research Scientists of M.Sc. and Ph.D. Levels, 1983 to 1987.

Discipline	Current Staff by Qualification *				Recruitment for Attrition	Net Additions at B.Sc. Level	Num. of Grants Required	
	BSc	MSc	PhD	DK	BSc		MSc	PhD
Silviculture	2	2	1	0	3	12	9	1
Dryland Afforestation	2	1	0	0	2	10	8	1
Com. Forestry	0	0	0	0	1	5	3	0
Forest Mensuration	0	1	0	0	1	5	3	1
Forest Products	1	1	0	0	2	7	6	1
Entomology & Zoo.	1	1	0	0	1	4	4	1
Forest Pathology	2	0	1	0	1	3	4	0
Forest Fires Res.	0	0	0	0	0	2	1	0
Seeds Res.	1	0	0	0	1	2	2	0
Other forestry	0	1	0	0	0	0	0	0
Totals	9	7	2	0	12	50	40	5

* Includes all staff currently in training at the degree level they will achieve upon return.

A major objective of the expanded Department of Forestry enumerated in the IBRD Report on the Fifth Education Credit Project is "initiating a postgraduate teaching program." However, no specific M.Sc. and Ph.D. graduate outputs are included in the projections, nor is there any substantive discussion of the structure and resources to be allocated to postgraduate training in the department. On the basis of our constrained demand projections, 40 forestry research scientists will require M.Sc. training between 1983 and 1987, assuming that the annual recruitment target of 12 graduates is met. (In addition, there is an urgent need for Kenyan university teachers with postgraduate qualifications in forestry subjects). It seems unlikely that the Department of Forestry at present can produce the required average annual output of eight M.Sc. graduates for forestry research until at least the mid- or late 1980s, and this will be dependent upon additional external technical assistance. The team was informed by the head of the Department of Forestry that a proposal has been submitted to a major donor requesting funding for five

technical assistance personnel over a five-year period in order to strengthen the postgraduate training program. In view of the urgent need for a rapid buildup in postgraduate training in forestry, this proposal is strongly supported.

M.Sc. courses should be tailored to the training requirements of the two types of graduate recruits, namely B.Sc. in forestry and general science. At present the number of forestry graduates with upper second degrees is very small (1 out of 8 in 1980, 0 out of 16 in 1981, and an anticipated 2 out of 16 in 1982). This can be partly attributed to inevitable teething problems and the shortage of experienced teaching staff, and can be expected to improve in the future. However, an additional factor is the relatively low quality of the "A"-level intake into the department (see Table 54). It is important, therefore, that efforts be made to improve the image of forestry as a career among school leavers in order to attract higher caliber students.

Until the Department of Forestry is able to produce the required number of postgraduate students, it will be necessary to send forestry research scientists to overseas universities. It is recommended, therefore, that donors should be approached in order to obtain assistance for about half of M.Sc. training courses which will be required each year. The "misappropriate orientation" of many forestry courses overseas, in relation to the specific forestry skills and knowledge required in Kenya is recognized as a serious problem. However, until adequate local training capacity can be developed, it is an unavoidable cost; but one that can be reduced through the careful selection of overseas courses and universities.

Ph.D. Training Requirements

The primary objective for forestry research is to ensure the projected levels of graduate recruitment and M.Sc.-level training for the next five years. Thereafter there will be greater scope for Ph.D. training. In the meantime it is recommended that five forestry research officers undertake Ph.D.-level training between 1983 and 1987 (i.e., about one should be sent each year).

CHAPTER 12

TECHNICAL SUPPORT STAFF FOR AGRICULTURAL RESEARCH IN KENYA

The report has so far concentrated on analyzing the demand and supply of agricultural research scientists, all of whom are university graduates. This is justifiable given that agricultural scientists are widely considered to be the key individuals in the generation of agricultural knowledge and in its application. However, they are by no means the only individuals. The technical staff that provide support in most of the experimental activities are very important in multiplying the effectiveness of the research scientists. The establishment of a well trained cadre of experimental or technical officers and assistants whose remuneration is commensurate with the essential roles they play in the research process has been shown to be an indispensable component of all successful national agricultural research systems. It is necessary, therefore, to examine the demand, supply, and utilization of technical support staff in the agricultural research system in Kenya.

Actual and Desired Ratios of Scientists to Technical Support Staff

Generalizations abound concerning the desirable ratios of professional technician and other "subprofessional" manpower which should prevail in developed and developing countries. Since agricultural research is no exception, the first task must be to try to formulate medium- and long-term target ratios on the basis of a realistic assessment of manpower requirements in relation to the supply and demand situation in the country as a whole.

The often-quoted ratio of 1 university-level scientist to 5 diploma-level technicians to 30 certificate-level technical assistants is certainly much too high in relation to the manpower requirements of agricultural research systems. Muturi estimates that the 1981 ratio of all agricultural research scientists to "technicians" was 1:1.16 in Kenya which, in fact, compares favorably with the corresponding ratios in other developing countries. From the data presented by Oram and Bindlish, only 21 out of a total of 64 developing countries in their sample had a higher scientist-technician ratio. In Sub-Saharan Africa, 5 out of 18 countries had a higher one. In Table 96 other Kenyan ratio estimates are presented for scientists, technical officers (diploma level), and technical assistants (certificate level) employed in the agricultural research system in the early 1980s, from which it can be seen that there is broad agreement on the relative number of these three strata of manpower. An examination of Table 97 reveals, however, that, as expected, there are considerable variations in these ratios among research stations in Kenya. This is the consequence of differences in the type of research activities being undertaken, but also of the relative abilities of research stations to recruit and retain support staff.

Unconstrained demand data for technical support personnel in the agricultural research system in Kenya are fragmentary and, therefore, difficult to interpret. In many respects, the paucity of information on

Table 96. Estimates of Actual Scientist and Diploma- and Certificate-Holder Stock Ratios for the Agricultural Research System in Kenya, early 1980s.

Sector	Ratios
All Research[1]	1 : 0.7 : 1.3
All Research[2]	1 : 0.8 : 1.5
Animal Production[3]	1 : 0.75 : 1.3
Ministry of Agriculture (Research and Extension) 1977	1 : 1.6 : 6.5

Notes: 1. Computed from NCST questionnaire returns, 1981.
2. ISNAR op. cit.
3. Ministry of Livestock Development, Research Division, Annual Report 1980-81 (unpublished).
4. ATAC op. cit.

future support personnel requirements compared with scientists is symptomatic of the relatively low status of this cadre in Kenya, and the lower priority that is attached to its development. We shall return to this issue shortly. The unconstrained demand estimates that do exist are presented in Table 98. It is interesting to also include the findings of a recent USAID agricultural manpower survey in Tanzania. While SRD and forestry research ratios are not significantly greater than the prevailing ratios in the early 1980s, those recommended by the Committee on Maize and Pasture Research and the Research Division of the Ministry of Livestock Development would require approximately 200% increases in the levels of support staff vis-à-vis the stocks of scientists employed.

The number of technical support staff must be determined on the basis of an assessment of the ability of the scientists whom they assist to provide them with work. The capacity of young inexperienced scientists to do this is much less than that of more experienced scientists. Even in well established agricultural research systems it is generally the case that the young scientist is only capable of conducting sufficient research to require the assistance of one experiment/technical officer and two technical assistants. Once he/she has gained a number of years experience this ratio may need to be increased to 1:2:4. While these ratios will, of course, vary within the research system, they are nevertheless useful indicators for establishing the overall number of technical support personnel, which in the absence of detailed station-by-station reviews must suffice. Given the lack of experience of the large majority of agricultural research scientists in Kenya, we recommend that a scientist to technical officer to technical assistant ratio of 1:1:2 be used for planning purposes. As pointed out in Chapter 6, however, it is important to monitor carefully the size of the support staff in order to prevent the proportion of budget spent on personal emoluments getting out of balance.

Table 97. Ratios of Scientists and Diploma- and Certificate-Level Technical Manpower Employed at Agricultural Research Stations in Kenya, 1981.

CROPS - National Stations	
ARD, Muguga	1 : 0.3 : 1.5
NARS Kitale	1 : 1.9*
NSRS Kibos	1 : 2.7*
NPBS Njoro	1 : 0.5 : n.a.
NAL Kabete	1 : 0.6 : 1.2
NHRS Thika	1 : 1 : n.a.
NDLRS Katumani	1 : n.a.
NPRS Tigoni	1 : 0.7 : 1.5
CRI	1 : 0.6 : 0.1
TRF	1 : 5.7*
CROPS - Regional Stations	
NRS, Kisii	1 : 1 : 3.8
PHRS, Molo	1 : 1.25 : 2.5
NYARS, OI Joro Crok	1 : 2.0 : 3.0
ARS, Embu	1 : 0.75 : 3.25
ARS, Mwea-Tebere	1 : 0.0 : 1.75
ARS, Mtwapa	1 : 0.25 : 1.0
CRS, Kibos	1 : 0.0 : 4.0
ANIMAL PRODUCTION - Stations	
NAHRS Naivasha	1 : 1.4 : 2.4
NRRS, Koboko	1 : 0.7 : n.a.
BRS, Lanet	1 : 1.33 : 0.33

* Includes both TDS and TAS.

Source: Computed from data contained in ISNAR Kenya's National Agricultural Research System, 1981.

Present Utilization of Technical Support Personnel

The foregoing analysis indicates that an insufficient number of support personnel are currently employed. However, the reasons for this are not entirely clear. It may be partly attributable to the considerable differences of opinion which prevail concerning the role which technical officers and technical assistants should play in agricultural research. A sizeable and influential group of scientists believe that, other than as farm managers, diploma-holders are generally not suited for employment as technical officers at research stations, since their training is primarily oriented towards extension activities. Hence, in the words of one very experienced station director, "They are like fish out of water." Some of this group believe that almost exclusive reliance

Table 98. Desired Ratios for Scientists and Diploma- and Certificate-Holders in the Agricultural Research System in Kenya.

Sector	Date	Ratios
Ministry of Agriculture (research and extension)[1]	1988	1 : 1 : 5.2
Ministry of Agriculture (research)[2]	n.s.	1 : 1.33 : 0.66 (all support staff)
Maize and Pasture[3]	n.s.	1 : 2 : 4
Forestry[4]	1993	1 : 0.6 : 1.1
Livestock[5]	n.s.	1 : 5 (all support staff)
Drylands Research[6]	n.s.	1 : 2 (all support staff)
Range Management[7]	n.s.	1 : 1 : n.a.
Research-Tanzania[8]	1987	1 : 0.93 : 1.65
Extension-Tanzania[8]	1987	1 : 0.83 : 3.8

Notes: 1. Computed from data presented in TAC, op. cit.
2. Interview with Deputy Director, Scientific Research Division.
3. Report of the Committee on Maize and Pasture Research, op. cit.
4-7. Submissions to 1982 ISNAR Mission.
8. USAID, Tanzania Agricultural Sector Manpower Study 1979-1986, Washington, USAID, 1980.

can be placed on technical assistants to undertake day-to-day experimental work, with laboratory technicians employed where necessary. Others argue, however, that there should be a cadre of "experimental officers" recruited from B.Sc. graduates as is the case in the majority of agricultural research systems in developed countries.

The above criticisms of diplomates engaged in agricultural research are in sharp contradiction with what we heard during our visits to research stations from a number of senior scientists who praised the work of their diplomates as technical officers. Several of them stated that the diplomates were of greater value to research programs than were many research officers. The Committee on Maize and Pasture Research was also impressed by the contributions made by technical officers but "were not satisfied with the recruitment, training, and retention of this cadre of staff."

It is our view that the current problems in the utilization of diplomates as technical officers stem from a failure to clearly define their role in the research system. The solution is not to dispense with them altogether but to create a parallel organizational structure for support staff which effectively complements the activities of the research

scientist and gives due recognition to the important role which both technical assistants and technical officers play in the research process. Remuneration must be based on productivity and not formal levels of certification. We recommend, therefore, that the two-tier support structure be maintained since certificate-level manpower is generally not capable of satisfactorily undertaking on its own sophisticated experimental work. To rely on technical assistants would be to downgrade the support function even further, and thereby seriously reduce the efficiency of research programs.

The absence of a well defined role for technical officers is reflected in frequently very high rates of attrition of diploma-holders from the research service. For example, at one of the national stations we visited, not one of the eight technical officers had been employed longer than three years. Career prospects are limited since technical officers cannot normally rise any higher than job grade J. The degree of overlap in the research and technical officer scales in Kenya is considerably less than it is in the majority of agricultural research systems in developed countries. In view of the critical importance of the technical support function, technical officer salary scales should be extended until at least job grade K. Only in this way will it be possible to attract and retain high-caliber personnel in support positions. (as discussed in Chapter 6).

At present the only real avenue of advancement beyond job grade J open to a technical officer if he decides to stay in the agricultural research system is to go for university-degree training and thereby secure entry into the research officer cadre. This is not desirable as a general case. The natures of the tasks and responsibilities of the research and technical officers differ; each should be evaluated and rewarded on criteria appropriate to the cadre. However, the avenue should be open for exceptional cases whose performance has shown that they would make good research officers, and also for relatively new diplomates who clearly would be able to benefit from the degree course. The initial distribution process into the university and college is by no means perfect. The University of Nairobi still insists that diploma-holders from Egerton College, who comprise the large majority of technical officers, must complete all three years of the undergraduate training course. This policy has been criticized as being too inflexible, and donors have preferred to sponsor technical officers to undertake shorter degree courses overseas -- most notably in the United States, which is much more costly. We understand from the Dean of the Faculty of Agriculture that preliminary discussions have been held to improve the coordination of courses at the university and at Egerton College so that technical officers wishing to pursue degrees can be exempted from some of the course work. We support this and recommend that a bridging program be introduced to facilitate the move to university training.

However, the support service cadre has its own role to play. Every opportunity should be taken to improve the competence of that cadre rather than to move expert technicians out to become perhaps indifferent research officers. An important factor will be the improvement of prospects <u>within the cadre</u> with a higher ceiling for good performers. In time it may be possible to attract science graduates to join such a respectable work force. Technical officers should be sent for appropriate in-service training courses to upgrade their technical competence or develop new skills (e.g., photogrammetry courses for survey

officers; tissue culture techniques for laboratory technicians; field research techniques for on-farm research; etc.). The caliber of recruits for the research support service could be improved if Egerton College offered a diploma with specialization in field experimental techniques, or perhaps a specialized in-service training course.

Past and Projected Supply of Agricultural Diploma- and Certificate-Holders

Diploma Level

Egerton College, Njoro, is the principal training institution for diploma-level agricultural manpower in Kenya, the majority of whom are subsequently recruited by the Ministries of Agriculture and Livestock Development as assistant agricultural officers III at job grade G (although they are called technical officers at agricultural research stations). The college was founded in 1939. As can be seen from Table 99, a wide range of courses are offered. Output doubled between 1971 and 1981, and will double again by 1985 as a result of a major expansion program financed mainly by USAID (see Table 100). The newly established Jomo Kenyatta College of Agriculture will train agricultural and engineering technicians and will have a total enrollment of approximately 720 students in about five years.

Table 99. Egerton College, Student Analysis by Course and Year of Study, 1981/82.

	1st Year	2nd Year	3rd Year	Total
Diploma in -				
Home Economics & Agriculture	30	20	22	72
Animal Husbandry	40	29	29	98
Animal Health	24	15	16	55
Agriculture	29	20	20	69
Horticulture	24	21	21	66
Farm Management	41	40	32	113
Dairy Technology	20	13	14	47
Food Technology	24	17	14	55
Agricultural Education	44	19	26	89
Soil & Water Engineering	25	19	15	59
Farm Power & Machinery	24	19	14	57
Range Management	32	18	15	65
Ranch Management	19	-	11	30
Wildlife Management	18	10	-	28
Totals	394	260	249	903

Source: Ministry of Agriculture.

Table 100. Past and Projected Supply of Diploma- and Certificate-Level Agricultural Manpower in Kenya, 1971 to 1987.

INSTITUTION	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Egerton College (Dipl Agr)	130	136	127	-	153	132	170	214	185	213	255	300	350	400	500	550	550
Jomo Kenyatta Agr.Ins.(Dipl)	-	-	-	-	-	-	-	-	-	-	-	-	-	86	86	86	136
Embu Agr.Institute (Cert.)	85	85	85	85	85	85	85	120	122	125	130	135	150	160	180	200	200
Bukura Agr.Inst.(Cert.)	85	85	85	85	85	85	84	115	120	125	130	135	150	170	185	200	200
Coast Agr.Inst. (Cert.)	-	-	-	-	-	-	-	-	-	-	-	-	-	200	200	200	200
Londiani Forestry College (Dip./Cert)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	35	35	35	35	35	35	35	35	35	35
Kabete Ahiti Cert.Animal (Health/Prod.)	-	-	-	-	-	-	97	100	125	125	125	125	125	125	125	125	125
Ndomba Ahiti Cert.Animal (Meat/Prod.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180	180
Naivasha Dairy Training School	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	100	110	120	130	140	150	150	150	150
Athi River Meat Training School	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Sources: Egerton College; Ministry of Livestock Development; Ministry of Agriculture; IBRD, Evaluation Reports of Education Credit Projects (various).

Kenya Polytechnic: Science and laboratory technician trainees are sponsored by their employers on block release and other types of courses at Kenya Polytechnic in Nairobi, which was originally established in 1960. Enrollments in the Applied Science Department at Kenya Polytechnic totalled 482 in September 1981. The examination results for 1979 are presented in Table 101.

There is widespread agreement within the research community that current outputs from Kenya Polytechnic are inadequate due to the serious shortages of well trained laboratory technicians. The situation will improve slightly with the creation of a training capacity of 40 laboratory technicians at Mombasa Polytechnic by 1984. A third polytechnic is also being planned with projected initial enrollments of 90 laboratory/process operation technicians, increasing to 240 by the late 1990s. It is still not clear when the first outputs can be expected. In the meantime greater reliance could be placed on the established training programs for biological laboratory technicians at the Faculty of Veterinary Medicine in order to increase the output of this manpower. Laboratory facilities could also be more fully utilized for teaching purposes at other research laboratories and we recommend, therefore, that the possibilities of seconding teaching staff to these institutions as a temporary expedient should be explored.

Table 101. East African Examination Correct Results for Laboratory Technician Students at Kenya Polytechnic, December 1979.

	Stdt. Total	Dist/ Credit	Pass	Refer	Fail	Rates % Pass	Refer	Fail
Sc.Lab.Tech.(Chem.)	27	7	15	4	1	81	15	4
Sc.Lab.Tech.(Chem.) (Repts)	11	0	3	0	8	27	0	73
Sc.Lab.Tech.(Biol.)	7	0	3	2	2	42	29	29
Sc.Lab.Tech.(Biol.) (Repts)	2	0	1	1	0	50	50	0
Sc.Lab.Tech.(Physics)	8	1	5	1	1	74	13	13
Totals/Mean Rates	55	8	27	8	12	61	25	14

Source: N. Kemp, An Evaluation of British Aid to the Kenya Polytechnic, 1981.

Finally, subprofessional forestry manpower at both the diploma- and certificate-level is trained at the Kenya Forestry College at Londiani, which was opened in 1957.

Certificate Level

Agricultural technical assistants are currently trained at four institutions. For crops, there is the Embu Institute of Agriculture, opened in 1947, and the Bukura Institute of Agriculture, opened in 1973. For livestock, there is the Animal Health and Industry Institute (AHITI), which was established in 1961, and the Dairy Training School at Naivasha. The ATAC Agricultural Manpower Survey estimated that given capacity levels of output from the four existing training institutes, there would be serious shortage of technical assistants during the 1980s. On the basis of the ATAC report recommendation that certificate-level training should therefore be considerably expanded, two new institutes are currently under construction at the coast and at Ndomba. Total annual output from these six training institutions is projected to be 1055 by 1987 (see Table 100).

Projected Demand and Supply of Technical Support Personnel for Agricultural Research, 1983 to 1987.

On the basis of a demand for research officers constrained by the likely availability of financial resources, we have estimated there should be 750 research scientists by 1987. With the same expected increase in total funding, and at current ratios of research scientist to technical officer and to technical assistant of 1:0.8:1.5, this would give 600 technical officers and 1125 technical assistants. The levels we recommend on the basis of ratios 1:1:2, are 750 technical officers and 1500 technical assistants.

The cost of supporting the extra 150 technical officers and 375 technical assistants constitutes a call on resources additional to the increase for supporting staff anticipated from its store of the overall increase in funding for agricultural research outlined in Chapter 5. Furthermore, as indicated in Chapter 6, we do not recommend finding any additional funds for technical staff from the already small proportion of research resources allocated to materials and facilities for carrying out the research program.

If the decision were made to increase the numbers of technical support staff towards the desirable ratio of 1:1:2, then we recommend this be accompanied with a decision to increase the proposed allocation to agricultural research above 1.5% of agriculture GDP. Otherwise, with a fixed ceiling, any increase in the proportion of technical support staff to research scientists will imply a reduction in the rate of net increse of research scientists to below the level of 38 per year: a trade-off position would have to be reached between benefits from improvement in research coverage due to increased numbers of scientists, and from improvement in efficiency from increased levels of technical support staff.

Assuming for the time being that an extra increase in funding for technical support is forthcoming (and it involves a relatively small adjustment in the balance of government funding between agricultural research and agricultural development), the above figures would imply net increases between 1982 and 1987 of about 300 technical officers and 650 technical assistants. Allowing for an attrition rate of 6% during this

period, the average annual recruitment rate for the period would have to be approximately 98 for technical officers and 204 for technical assistants.

The average annual output of diploma-holders between 1983 and 1987 will be 548; the 98 needed annually by the agricultural research system represent nearly 18% of this figure. Assuming there are no dramatic changes in the pattern of demand for diploma graduates, this would appear to be attainable. Although the corresponding percentage figure for certificate-holders of 23% is considerably higher, we do not feel that this is an unrealistic target in view of the very large increases in the output of agricultural certificate-holders during the next five years. Some of the new technical support staff would be recruited from Kenya Polytechnic and other institutions but it is clear that the college and institutes of agriculture will have to provide the bulk of the recruits.

CHAPTER 13

CONCLUSIONS AND RECOMMENDATIONS

The main conclusions and recommendations are grouped and summarized below according to the major areas of this manpower and training plan.

Manpower Surveys.

- There is an urgent need for a comprehensive and detailed agricultural manpower survey (as opposed to a research manpower survey). Manpower and employer categories should be carefully specified and, in view of the importance of postgraduate training to agricultural research, particular attention should be given to assessing employer demand for this type of training outside the government agricultural research service.

- Additional information on career histories including salaries, and job and training evaluations would be highly valuable in formulating recruitment, posting, and training policies for agricultural research scientists. Ideally this should be collected as part of a "tracer" sample survey of agricultural and possibly general science graduates from the University of Nairobi in order to ascertain their present whereabouts. Such a study could be undertaken by social science research students at the University of Nairobi, perhaps in conjunction with more experienced researchers at the Institute for Development Studies.

- The Ministry of Higher Education should introduce a data collection and retrieval system on students training at overseas institutions.

Net Increase in the Number of Agricultural Research Scientists, 1983 to 1987

- Unconstrained demands cannot be totally satisfied during the next five years. Under likely financial constraints and a modest increase in investment in agricultural research to 1.5% of agricultural GDP, average net additions to the stock of agricultural research scientists should be approximately 38 per year between 1983 and 1987.

- Based on assumptions of national research priorities and existing staff the breakdown of these increases between the major areas of agricultural research should be: crops, 15; forestry, 10; animal production, 11; and veterinary, 2.

The Training Strategy

- An undergraduate internship program should be reintroduced.

- For crops scientists, attendance of short courses at IARCs should be encouraged after approximately one year of on-the-job experience.

- All agricultural research scientists who are academically qualified and who satisfactorily complete a two-to-three-year "apprenticeship" should be sent for formal M.Sc. training as soon as possible.

- Highly competent officers who have demonstrated their academic and on-the-job ability should be selected for Ph.D. study.

Graduate Recruitment Requirements and Projected Supply, 1982 to 1987: Quantitative Aspects

- Taking into account these net increases and assuming a rate of attrition of 6% per annum, annual recruitment between 1983 and 1987 into the major agricultural research areas should be: crops, 40; forestry, 12; animal production, 16; and veterinary, 8.

- Current expansion programs at the Faculty of Agriculture are highly necessary, particularly the assistance being given to the Departments of Forestry and Range Management.

- A B.Sc. (animal production) course should be established as a matter of priority.

Graduate Recruitment Requirements and Projected Supply, 1982 to 1987: Qualitative Aspects.

- Attempts should be made to improve the caliber of the "A"-level input into the Faculties of Agriculture and Veterinary Medicine. There should be greater publicity about careers in agriculture in secondary schools.

- It is essential that the agricultural research system attract a high proportion of recruits with upper second- and first-class degrees.

- Recruitment of all graduates into agriculture and livestock activities should be centralized so as to ensure that recruitment targets can be satisfied and that graduates are directed to the areas of greatest shortage.

Postgraduate Training: Quantitative Aspects.

- On the basis of the recommendation that all agricultural research scientists be sent for M.Sc. training after two to three years of service, average annual M.Sc. training requirements between 1983 and 1987 for each of the major areas of research are: crops, 50; forestry, 8; animal production, 11; and veterinary, 10.

- For Ph.D.-level training it is recommended that the following average annual intakes be adopted: crops, 9; forestry, 1; animal production, 3 to 4; and veterinary, 2 to 3.

- For crops research, approximately 20 scientists should be sent each year to IARCs from 1983 to 1987.

- The postgraduate training capacity of the Faculties of Agriculture and Veterinary Medicine at the University of Nairobi should be expanded considerably. The proposed agricultural manpower study should ascertain the overall increases which will be required to meet national requirements.

- Approximately 75% of M.Sc.- and 40% of Ph.D.-level training for agricultural research should be conducted at the two faculties by 1987. Continued reliance will have to be placed on more specialized training courses overseas which cannot be provided at the university.

Postgraduate Training: Qualitative Aspects

- Postgraduate courses should be separately and adequately funded.

- Such courses should be programmed, advertised well in advance, and more specialized than at present. The main sponsors of postgraduate students should in return inform the faculties of their requirements in good time.

- The different training needs of B.Sc. (agriculture) and B.Sc. (science) graduates should be recognized when planning postgraduate programs.

- Second-year students who return to their research stations should be allowed to concentrate exclusively on their M.Sc. project work.

- Provision should be made for supervisors to visit students at research stations more frequently.

Technical Assistance for Agricultural Research

- At present the "tied" nature of training scholarships attached to specific research projects does not allow sufficient flexibility and control in planning training programs for the agricultural sector as a whole.

- The significant increase in the proportion of technical assistance allocated to local training in recent years is a welcome development which should be sustained and, wherever necessary, encouraged.

- There is still an urgent need for expatriate research scientists given the rapid expansion and relative inexperience of the Kenyan research scientist cadre.

- The training function of expatriate scientists should be increased and clarified in order to avoid conflicts with other objectives.

Technical Support Staff

- The current ratio of support staff to research staff is low for efficient use of research staff. It is recommended that the scientist-technician-technical assistant ratio should be increased to 1:1:2 from 1:0.8:1.5. To implement this will require additional funding or a reduction in the role of increase of research scientists.

- The two tiers of technical support personnel should be maintained, but their roles in research should be clarified.

- There should be greater recognition of the work of technical support personnel; hence consideration should be given to increasing the degree of overlap between the salaries of scientists and such personnel.

- Technical officers who have the academic ability and have performed well on the job should be allowed to go for degree training.

APPENDIX 1

People We Met

Ministry of Agriculture

Headquarters

Mr. J.K. Gitau
Director of Agricultural Research

Mr. J. J. Ondieki
Deputy Director of Agricultural Research

Mr. W. N. Wandamu
Senior Executive Officer

Ms. P. Mwiga
Training Officer

Crops Research Stations

Mr. A.P.M. Marimi
Director, National Drylands Farming Research Station, Katumani

Mr. J. K. Mavua
Research Officer, National Drylands Farming Research Station, Katumani

Mr. S. M. Nandwa
Director, Agricultural Research Station, Mwea-Tebere

Mr. S. K. Njuguna
Director, National Horticulture Research Station, Thika

Mr. H. H. A. Mulamula
Senior Research Officer, National Plant Breeding Station, Njoro

Mr. W. W. Wapakala
Director, National Sugar Research Station, Kibos

Ministry of Environment and Natural Resources

Mr. O.M. Mburu
Chief Conservator of Forests

Ministry of Finance

Mr. N. Barasa
Assistant Secretary

Mr. T. A. Spence
World Bank Expert

Ministry of Higher Education

Ms. A. D'Souza
Senior Planning Officer

Ministry of Livestock Development

Headquarters

Dr. S. Chema
Director of Research

Dr. J. Barasa
Chief Training Officer

Dr. D. P. Kariuki
Research Officer, Veterinary Research Laboratories, Kabete

Dr. E. W. Allenby
Head, UNDP/FAO Sheep and Goats Project

Livestock Research Stations

Mr. N. Musimba
Director, National Rangeland Research Station, Kiboko

Mr. G. A. Kamau
Director, National Animal Husbandry Research Station, Naivasha

Ministry of Regional Development, Science, and Technology

Prof. P. Gacii
Permanent Secretary

Kenya Agricultural Research Institute

Dr. B. N. Majisu
Director

Dr. J. D. Wachira
Director, Animal Production Department

Dr. W. N. Masiga
Deputy Director, Veterinary Research Department

Dr. B. N. Ngundo
Deputy Director, Agricultural Research Department

Office of the President

Cabinet Affairs

Dr. D.R. Campbell
Economic Adviser

Directorate of Personnel Management

Mr. P. M. Ndikwe
Senior Management Analyst

Mrs. M. S. Mukwana
Management Analyst

Mr. J. J. M. Nzau
Accountant

Mr. D. N. Mbai
Senior Planning Officer (Establishment)

University of Nairobi

Dr. D. N. Ngugi
Dean, Faculty of Agriculture

Dr. F. Owino
Head, Department of Forestry

Prof. G. M. Mugera
Dean, Faculty of Veterinary Medicine

Mr. A. Kataka
Assistant Registrar (Admissions)

Mr. S. G. Njuguna
Assistant Registrar (Examinations)

Egerton College, Njoro

Dr. R. Musangi
Principal

Representatives of Other National Governments and International Organizations

Ms. K. Peterson
Program Officer, UNDP

Mr. J. Coupe
Education Officer, British Council

Mr. C. T. Hash
Head, Agricultural Division, USAID

Mr. F. Holmes
Training Officer, USAID

Dr. M. Collinson
Representative, East African Regional
Office, CIMMYT

Mr. N. Krafft
Agricultural Officer, IBRD

APPENDIX 2

Survey of Agricultural Research Scientists in Kenya, June 1982

A survey of agricultural research scientists had not been originally envisaged. However, the team needed to analyze systematically the staffing information it received from a variety of different sources in order to derive manpower and training strategies. The most important information included:

- Detailed and up-to-date lists of research officers employed at crops research stations (provided by the Director of Research, Ministry of Agriculture). These valuable lists contained information on qualifications, area of work, suggested training requirements, years of work experience, and designation.

- 1981 Scientific Research Division staff lists of research officers, technical officers, and technical assistants. This was updated to include graduate recruits up to June 1982 and, with the assistance of Mr. Wandamu, a senior executive officer in SRD who had detailed knowledge of the staffing situation at crops research stations, it was possible to make corrections for resignations, transfers, those in training, and new recruits.

- 1979 Scientific Research Division staff lists contained additional information on each research scientist employed such as date and place of undergraduate and postgraduate training and commodity and/or discipline specialization.

- Section 7 of Questionnaire B of the NCST Survey of Resource Allocation in Agricultural Research which requested information on the involvement of individual scientists in ongoing research projects. These data were particularly useful in ascertaining the types of commodities that scientists were researching. Approximately 300 scientists were enumerated. Response rates for crops and animal production research projects appeared to be good, but few project returns were completed for veterinary research.

- Up-to-date computer printouts for all scientific staff employed in the Research Division of the Ministry of Livestock and Development, and also additional information on 1982/83 Ph.D. and M.Sc. staff training requirements.

- Current staff lists were obtained from all four research divisions of KARI.

- Submissions to the 1981 and 1982 ISNAR teams.

- Names of agricultural research scientists sponsored for overseas postgraduate training by the United States and United Kingdom governments since 1979/80.

Data from these various sources were recorded on a separate index card for each scientist. A color coding system was adopted in order to indicate the reliability of the information. Only scientists on current staff lists and those confirmed as being in post by the senior Executive Officer were coded as being reliable and included in the survey. In all some 120 names were excluded. Because Kenyans are sometimes known by more than one name we tried to ensure, by checking initials and personal details, that scientists were not included twice.

The survey data was entered into a small Wang computer at ISNAR's headquarters. The codebook used for this exercise is reproduced in Appendix 3.

APPENDIX 3

Codebook Used for Data Analysis of Agricultural Research Scientist Survey, 1982

FIELD 1 - Name (20 spaces)

FIELD 2 - Nationality (1 space)

1 - Kenya
2 - Tanzania
3 - Uganda
4 - other Africa
5 - other non-Africa LDC
6 - North America
7 - Europe
8 - Japan
9 - other "north"
0 - unknown

FIELD 3 - Station (2 spaces)

01 - (KARI) Muguga - Agricultural Research Department
02 - SRD Nairobi - Scientific Research Division (MOA)
03 - Kitale - National Agricultural Research Station (NARS)
04 - Kibos - National Sugar Research Station (NSRS)
05 - Njoro - National Plant Breeding Station (NPBS)
06 - Kabete - National Agricultural Laboratories (NAL)
07 - Thika - National Horticulture Research Station (NHRS)
08 - Katumani - National Dryland Research Station (NDRS)
09 - Tigoni - National Potato Research Station (NPRS)
10 - NSQCS (Lanet) - National Seed Quality Control Services

11 - Kakamega - Western Agricultural Research Station (WARS)
12 - Kisii - Nyanza Agricultural Research Station
13 - Molo - Pyrethrum & Horticultural Research Station (PHRS)
14 - Ol Joro Orok - Nyandarua Agricultural Research Station
15 - Embu - Embu Agricultural Research Station
16 - Mwea-Tebere - Mwea-Tebere Agricultural Research Station
17 - Mtwapa - Coast Agricultural Research Station (CARS)
18 - Kibos - Cotton Research Station (CRS)
19 - Kisuru - Ahero Irrigation Research Station
20 - Pekerra - Pekerra Agricultural Research Station

30 - (KARI) Muguga - Animal Production Research Department
31 - Central Office, Ministry of Livestock Development
32 - Naivasha - National Animal Husbandry Research Station (NAHRS)
33 - Kiboko - National Range Research Station (NRRS)
34 - Mariakani - Animal Husbandry Research Station
35 - Lanet - Beef Research Station (BRS)
36 - Kitale - Animal Production Research
37 - Livestock (MOLD) - not known/others

40 - (KARI) Muguga - Veterinary Research Department
41 - Kabete - Veterinary Research Laboratories (VRL)

51 - (KARI) Muguga - Forestry Research Department

61 - Coffee Research Foundation (CRF)
62 - Tea Research Foundation (TRF)

00 - unknown

FIELD 4 - Agroclimatic Zone (2 spaces)

01 - high altitude
02 - high potential - upland
03 - medium potential - upland
04 - medium potential - coastal
05 - semi-arid
06 - range
07 - arid north
00 - unknown

FIELD 5 - Year of First Degree (2 spaces)

FIELD 6 - Highest Educational Qualification (2 spaces)

01 - certificate
02 - diploma
03 - B.Sc. (science)
04 - B.Sc. (agriculture)
05 - BVM
06 - postgraduate diploma
07 - M.Sc
08 - DVM
09 - Ph.D.
99 - other
00 - unknown

FIELD 7 - Year of Highest Educational Qualification (2 spaces)

FIELD 8 - Place of Highest Educational Qualification (10 spaces)

FIELD 9 - Years of Experience (2 spaces)

FIELD 10 - Year Into Service (2 spaces)

FIELD 11 - In Training? (1 space)

1 - yes, B.Sc.
2 - yes, M.Sc.
3 - yes, Ph.D.
4 - yes, short course
5 - under consideration/ "to go"

9 - no
0 - unknown

FIELD 12 - Where In Training? (10 spaces)

FIELD 13 - Discipline (2 spaces)

Agriculture (crops and soils)

01 - breeding and genetics
02 - agronomy and plant physiology
03 - soils and plant nutrition
04 - soil physics, minerology, etc.
05 - entomology
06 - plant pathology (incl. nematology)
07 - agricultural mechanization (engineering)
08 - soil and water conservation
09 - irrigation/agrometeorology
10 - agricultural economics/biometry
11 - agricultural extension and education
12 - rural social science
13 - food science and technology
14 - chemistry
15 - sericulture
19 - other agriculture/not specified

Animal Production

20 - breeding and genetics
21 - animal nutrition
22 - reproductive physiology (incl. AI)
23 - production and management
24 - forage and pasture improvement
25 - range management/ecology
29 - other animal production/not specified

Veterinary

30 - bacteriology
31 - biochemistry/chemistry
32 - helminthology
33 - pathology
34 - protozoology
35 - immunology
36 - virology
37 - diagnostic services
39 - other veterinary

Forestry

40 - silviculture
41 - agroforestry

42 - dryland afforestation
43 - mensuration and economics
44 - forest products
45 - entomology

46 - pathology
49 - other forestry

General Science

50 - chemistry
51 - physics
52 - botany
53 - zoology
54 - entomology
55 - pathology
56 - statistics and biometrics
57 - economics
59 - other social science

60 - administration

00 - unknown

FIELD 14 - Commodity (2 spaces)

Cereals

01 - maize
02 - wheat, barley, and triticale
03 - sorghum and millet
04 - rice
07 - seeds
09 - other

Grain Legumes

10 - dry beans
11 - cowpea
12 - pigeon pea
13 - grain legumes
19 - other

Roots and Tubers

20 - white potato
21 - cassava
22 - sweet potato/yam
29 - other

Oil Seeds

31 - sunflower
32 - groundnut
33 - oil seed crops
39 - other

Horticulture

40 - vegetables
41 - tree crops
42 - citrus
43 - floriculture
44 - horticulture

45 - fruit
46 - silk
49 - other

Cash Crops

50 - coffee
51 - tea
52 - pyrethrum
53 - tobaco
54 - coconut
55 - sugar
56 - cotton
57 - cashew, macademia, and other nuts
59 - other

Livestock

60 - beef
61 - dairy
62 - sheep and goats
63 - poultry
64 - swine
65 - range management
66 - forage and pasture management
67 - wildlife
69 - other

Other

70 - sericulture

00 - unknown

FIELD 15 - Designation (8 spaces)

FIELD 16 - Grade (1 space)

1 - G
2 - H
3 - J
4 - K
5 - L
6 - M
7 - N
8 - P and over
0 - unknown

FIELD 17 - Data Reliability (1 space)

1 - positive
0 - questionable

APPENDIX 4

List of Acronyms

ASARC	Agricultural Sciences Advisory Research Committee
ARS	Agricultural Research Station
ATAC	American Technical Assistance Center
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CIP	Centro Internacional de la Papa
DPM	Directorate of Personnel Management
FAO/UNDP	Food and Agricultural Organization/United Nations Development Programme
FRS	Forest Research Station
IARC	International Agricultural Research Center
IADP	Integrated Agricultural Development Project
IBRD	International Bank for Reconstruction and Development (The World Bank)
ICARDA	International Center for Agricultural Research in Dry Areas
ICRISAT	International Center for Research in the Semi-Arid Tropics
ICIPE	International Center for Insect Physiology and Ecology
IITA	International Institute of Tropical Agriculture
ILRAD	International Laboratory for Research in Animal Diseases
ISNAR	International Service for National Agricultural Research
KARI	Kenya Agricultural Research Institute
LDC	Less Developed Country
MENR	Ministry of Environment and Natural Resources
MOA	Ministry of Agriculture
MOLD	Ministry of Livestock Development
MRDST	Ministry of Regional Development Science and Technology
NCST	National Council for Science and Technology
SMS	Subject Matter Specialist
SRD	Scientific Research Division
T & V	Training and Visit
UGC	University Grants Committee
USAID	United States Agency for International Development

APPENDIX 5

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