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9. ABSTRACT

This discussion of agricultural research in Kenya covers organization and administration, national research programs, non-research functions, foreign donor assistance, and priority areas for future research. The primary problem is that of attracting and retaining competent technical people. The pay scale, which is low in comparison with other institutions, provides no incentive, and there is little prospect for status or promotion to someone thinking of career in agricultural research. Recommendations include: revision of the salary scale and scheme of service to be competitive, development of a screening and probationary system to assure that time and resources are not wasted and appointment of subject matter specialists to keep the Extension Service advised of the latest information. Also recommended are the establishment of an information office to translate this to the extension service, a review of the distribution and location of research stations and demonstration sites, the development of a policy on the selection of counterparts to work with expatriate scientists, and the establishment of workshops for the repair of machinery, equipment and vehicles. The following research areas need strengthening: range management, drylands agriculture, coastal agriculture, plant pathology, entomology, horticulture, and weed science. The following research areas need strengthening and could use foreign assistance to good advantage; nitrogen fixation in grasses, mixed cropping and multiple cropping, high quality protein sorghum, and rice research.

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Agricultural Research in Kenya

REVIEW AND ASSESSMENT OF THE AGRICULTURAL RESEARCH CAPABILITIES AND EFFECTIVENESS OF THE SCIENTIFIC RESEARCH DIVISION, MINISTRY OF AGRICULTURE

Submitted to:

U.S. AID Mission to Kenya
and
Government of Kenya

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Russell Desrosiers
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Nairobi, Kenya
September 1977

Table of Contents

Section		Page
--	SUMMARY	1
I	ORGANIZATION AND ADMINISTRATION	
	A - Resources	5
	B - Management	18
	C - Interrelationships and Linkages	30
	D - Assessment and Recommendations	33
II	NATIONAL RESEARCH PROGRAMS	47
III	NON-RESEARCH FUNCTIONS	
	A - Service Functions	53
	B - Regulatory Functions	53
IV	FOREIGN DONOR ASSISTANCE	
	A - Foreign Donor Support for Agricultural Research	55
	B - Project Design and Selection of Donor Agency	56
	C - Foreign Donor Technical Assistance and Training	57
V	PRIORITY AREAS FOR FUTURE RESEARCH	
	A - Broad Areas of Research in Need of Strengthening	59
	B - Specific Research Programs Recommended for Initiation or Strengthening	60

Abbreviations

ADA/APR	Assistant Director of Agriculture/Animal Production Research
ADA/DR	Assistant Director of Agriculture/Development Research
ADA/SR	Assistant Director of Agriculture/Services Research
AIE	Authority to Incur Expenditure
ATAC/GRC	American Technical Assistance Center, General Research Corporation
CIAT	Center for Tropical Agricultural Research
CIDA	Canadian International Development Assistance
CIMMYT	International Center for Research on Maize and Wheat
DA	Director of Agriculture
DAO	District Agriculture Officer
DDA	Deputy Director of Agriculture
DOR	Director of Research
EAAFRO	East African Agriculture and Forestry Research Organization
EAC	East African Community
EAVRO	East African Veterinary Research Organization
GOK	Government of Kenya
ICIPE	International Center of Insect Physiology and Ecology
ICRISAT	International Center for Research in the Semi-Arid Tropics
IITA	International Institute of Tropical Agriculture
LPO	Local Purchasing Order
MOA	Ministry of Agriculture
MOF/A	Ministry of Finance and Planning
NAL	National Agricultural Laboratories
NARS	National Agricultural Research Station
PDA	Provincial Director of Agriculture
PF & EO	Principal Finance and Establishment Officer
PRAC	Provincial Research Advisory Committee
PS	Principal Secretary
RS	Research Station
SRD	Scientific Research Division
USAID	United States Agency for International Development

SUMMARY

Agricultural research has an honored tradition in Kenya dating back more than 70 years, and the Division of Scientific Research of the Ministry of Agriculture is carrying on that tradition in a very able manner. The Division possesses an impressive physical plant including a network of 26 research stations distributed so as to cover the various ecological zones of the country. Leadership of the Division is highly competent, the stations quite well equipped and adequately financed.

The primary problem facing the Research Division is that of the attraction and retention of competent technical staff. There is a small body of experienced, well trained and dedicated people who carry the load of conducting the research and managing the organization. These people are few in number, however, and there is a large and ever-changing population of newly inducted personnel, many of whom remain in the service for only a short time.

The reason for this is the lack of incentive provided by the pay scale, which is low in comparison with other institutions, and the scheme of service, which offers little prospect for promotion and status to one who contemplates making a career of research. The scheme of service is the problem which must be corrected in order to improve the service and build up the staff of experienced and well trained scientists. Short term measures to train people and provide expatriate scientists for brief periods are valuable to increase temporarily the output of research but do little to improve the service. Only the solution of the scheme of service problem, by making the Research Division attractive as a career opportunity, can provide long term improvement.

The following recommendations are offered for consideration:

A. Organizational and Functional

- Revise the salary scale and scheme of service of the Research Division so as to be competitive with other research institutions and the University. The scheme of service should permit research scientists to

achieve the highest grades and remuneration independently of the management ladder.

- Similarly, a major effort should be made to attract and retain competent support personnel such as executive officers, accountants, mechanics, etc., in order to maximize the effectiveness of research personnel and administrators.

- Develop a screening and probationary system to assure, to the greatest extent possible, that time and resources are not wasted in the education and training of personnel who do not plan to make a career of the research service.

- Upgrade the Scientific Research Division to Department level on a par with the Extension Service and the Department of Veterinary Service.

- Assure that the agricultural research installations of former East African Community in Kenya are preserved and strengthened and continue to work for Kenyan agriculture.

- Appoint subject matter specialists to keep the Extension Service advised of the latest information and to handle emergencies. These, in some cases, could work out of the specialist laboratories in Nairobi (Plant Pathology, Entomology, Soil Testing) and, perhaps, some of the existing staff could assume this function.

- Develop a definite policy of using the above mentioned specialist laboratories as a training ground for new personnel by requiring aspirants in the given fields to serve short tours of duty in the appropriate laboratories. These facilities may also be used in training sessions for extension personnel.

- Establish an Information Office within the Research Division with the responsibility to translate all new research information immediately into layman's terms and to transmit this to the Extension Service. This office would also be charged to maintain constant liaison with the Extension Service, promote a definite policy of field days and seminars at all research stations, with the material presented in simple terms, and organize regular meetings of the Provincial Research Advisory Committees.

- Improve and strengthen the existing Information Center of the Extension Service by providing additional personnel and new equipment.

- Have the Soil Survey and Land Use Section review the distribution and location of research stations and demonstration sites and advise on whether the present distribution is economical and efficient or whether there should be more or fewer sites.

- Develop a definite policy on the selection of counterparts to work with expatriate scientists. Counterparts should be selected on the basis of aptitude, interest, education and, if possible, prior experience in the field of the expatriate. Counterparts should not be transferred. At the same time, expatriate scientists should be required to devote careful attention to the training of counterparts.

- Explore the possibility of establishing a relationship with one or more universities or research institutes abroad which would permit an exchange of personnel, with expatriate scientists working in Kenya and Kenyans taking advanced study abroad.

- Establish a central economics service within the Research Division to service all stations primarily with analyses of costs and returns on investment to be expected from new agricultural practices.

- Assure that adequate library facilities, including technical journals, or an effective central reference support system exist throughout the network of research stations in such a way that the facility is conveniently available to all of the personnel.

- Workshops for the repair of machinery, equipment and vehicles, staffed with competent personnel and stocked with spare parts, should be established at the principal stations and be prepared to service smaller stations as well. Alternatively, a central facility might be established in Nairobi for this purpose.

B. Technical

1. Broad Areas of Research in Need of Strengthening

The following are areas of research in which the Research Division already has good work in progress but for various reasons, mainly scarcity of personnel, is not advancing as rapidly, or covering the ground as thoroughly as might be desired. These are areas in which foreign assistance and expatriate scientists as well as training programs abroad might be needed.

a. Range management and ecology of arid lands
b. Drylands agriculture
c. Coastal agriculture
d. Plant pathology
e. Entomology
f. Horticulture
g. Weed science

2. Specific Research Projects Recommended for Initiation or Strengthening

The following research projects, some of which are already in progress but need strengthening, are ones in which foreign assistance, the presence of expatriate scientists, and training programs abroad could be used to good advantage.

a. Nitrogen fixation in grasses
b. Mixed cropping and multiple cropping
c. High quality protein sorghum
d. Rice research

I. ORGANIZATION AND ADMINISTRATION

A. RESOURCES

1. Budget

The 1977/78 Research Division Budget is K£3,677,279 (Tables 1, Annex A). This represents about 7.8 per cent of the total MOA budget for FY 1977/78 (Table 2, Annex A). The Division's recurrent expenditures are K£2,201,995 which represents 55 percent of the division's total. (Table 3, Annex A). Development expenditures are K£1,475m274 representing 45 per cent of the total division budget. The Division's recurrent expenditures are higher than its development expenditures mostly becuase of the costs of maintaining the more than 26 research stations attached to the Division. The MOA's recurrent expenditures equal about 40 percent of the total budget and development expenditures are 60 percent (Table 3, Annex A).

The Division received most of its receipts from direct government allocations. Foreign donor aid is channelled directly to the support of specific projects. Appropriations in aid contributed 10 percent to the budget (Table 4, Annex A). Appropriations in aid are receipts realised from the sales of equipment and production from the research stations like cattle, seeds, and milk.

Crop research received the largest budgetary allocation K£1,869,873, of the six sections in the division. Grain storage and handling received the next largest allocation of K£660,833. This money is earmarked entirely for capital development and represents a large one-time expenditure. The remaining budget is divided between animal husbandry research, regulatory services, range research and headquarters expenses, in that order.

Crop research traditionally is the largest user of funds, being the oldest area of research in the country. Most of its funds - 74 percent - are used to cover recurrent expenditures. Crop research uses the largest portion of the recurrent budget (64.9 percent) and the second largest portion of the development budget (30 percent). These figures would indicate the continuing high priority placed on crops and crop research for the agricultural sector. A quick glance at the development expenditures

broken down by project (see Table 7, Annex A) shows that crop development research priorities are beginning to shift to marginal lands research. Dryland farming and irrigation research received the largest development funding with the exception of the one time grain storage and handling expenditure.

Animal husbandry traditionally follows crop research as the second largest user of funds. It however, lags far behind crop research, with 18.5 percent of the total recurrent and 12 percent of the development budget allocated to it. Animal husbandry research is still in an expansionary phase with 43 percent of its allocation devoted to development/capital expenditures (Table 5, Annex A).

Regulatory services use only a small portion of the total research budget. Six point three (6.3) percent of the total recurrent and 11 percent of the total development budget are allocated for these essential services (Table 4, Annex A). Regulatory services are not new to Kenya, but they require additional development to bring them up to required capacity. Recognizing this, 66 percent of the regulatory services budget is schedule for development expenditures (Table 5, Annex A).

Range research is the newest area of study within the division. Its importance is growing with the increasing emphasis placed on marginal land development. Impressive beginnings have been made in range research with the development of the Kiboko Research Station and its sub-stations. Its importance, however, is hidden by its small budget. Only 2 percent of the development and 6.7 percent of the recurrent budgets go to range research. Staff is still very much in short supply. Range research is in its nascent stages of development and until the staff constraint is addressed range research will, in all probability, continue to receive a relatively small allocation; and will continue to devote only a small portion of its budget to development expenditures (presently 22 percent of the division's budget).

Headquarters is the smallest user of the division funds, representing 3.3 percent of the total recurrent budget and none of the development budget. Its largest expenditure is its contribution to the Coffee Research Station (K£25,000).

a. Three Year Estimates and Research Priorities

The three year forward budget estimate submitted to Treasury indicate some shifts in research emphasis. Range research receives a larger piece of the development budget, upto 11.5 percent for 1978/79 vs. the present 2 percent. Animal husbandry and crop research development expenditures also rise while the amount taken by grain storage and handling drops significantly. Recurrent expenditures are distributed in the same way as they are now. (See Tables 8 and 9, Annex A).

b. The (former) East African Community Agricultural Research Organization: Budgets.

Of the former East African Community agricultural research organizations, two of them, EAAFRO and EAVRO, have the bulk of their operations in Kenya. The EAIRO has about a third to one-half of its operations located in Nairobi. The total net budgets for these three organizations plus the budget for the Joint Services Division of EAAFRO & EAVRO totalled approximately K1.69 million for 1976/77 (See Table 10, Annex A). This represents about 46 percent of the Research Division's current year total gross expenditures. The revenue to meet the East African Community expenditures comes mostly from the EAC General Fund Services, e.g., revenues generated through tarrifs, levies, taxes, and returns of investments. Direct contributions from the former members states, rents and rates, donor assistance, and other miscellaneous contributions make up the remaining sources of revenue. The break-up of the Community has put the future of the East African organizations in some doubt. The Government of Kenya apparently is covering the present cost of some of the Community organizations located in Kenya including the three Kenya based agricultural research organizations. It is not yet clear how the GOK plans to raise the funds required to meet their respective budgets in the future.

2. Resources

The land and capital resources available for agricultural research are impressive for their sufficiency and adequacy. The Research Division has twenty-six (26) main research stations, sub-stations and regulatory installations, and 16 minor sub-stations used for field testing. Twenty

four of the twenty six stations on which land surveys have been carried out and own and occupy 40,736 hectares of land (100,618 acres) (see Table 1). With this amount of land available for research purposes it should come as no surprise that most of the heads of stations interviewed were satisfied with the land resources. The one notable exception was the National Plant Breeding Station at Njoro where it was felt that additional land is required to accomodate oilseed research.

Office and laboratory space was found to be generally sufficient and no major complaints were expressed by Divisions officials and heads of stations. In fact, the office and laboratory space appeared quite impressive to the research assessment team.

Laboratory and field testing equipment was generally found to be sufficient, and quite impressive. The equipment constraints, where they existed, were quite minor and would require very small capital outlays, or transfers of unused equipment between stations.

Insufficiency of housing and social amenities was a problem at several of the stations visited. Junior and middle level staff housing is in short supply and requires expansion at several places but senior staff housing was adequate. Social amenities, like a station social center, were very much lacking at the Kiboko National Range Research Station, presenting, quite frankly, a hardship to the staff.

Vehicles, including automobiles, lorries, and tractors, though generally sufficient in numbers, were often out of service and in need of repair. In a few stations visited, the vehicle repair problem hampered operations. Generalizing from these stations, and from the complaints heard in the field, the repair and maintenance problem, in all probability, pervades most of the stations and their operations.

The regulations governing repair of vehicles were necessarily strict from an accounting point of view. From an operational point of view, these regulations hampered timely repair, and were generally an inconvenience. For example, moving broken down vehicles to the Ministry of Works maintenance stations for the initial examination and cost estimates as specified in the regulations can be difficult with no assurance that the MOW can carry out the repairs because of their lack of staff and heavy work load. In the

TABLE 1 (a)

TABLE OF AGRICULTURAL RESEARCH STATION

RESEARCH STATION	AREA	ALTITUDE	RAINFALL	STATUS
National Agricultural Laboratories	25hs.	1740m.	970mm.	National Station
National Agricultural Research Station Kitale	311ha.	1860m.	1190mm.	" "
National Horticultural Research Station Thika	365ha.	1500m.	1020mm.	" "
National Plant Breeding Station Njoro	202ha.	2200m.	940mm.	" "
National Sugar Research Station Kibos	212ha	1170m.	1208mm.	" "
Cotton Research Station Kibos	15ha.	1170m.	1280mm.	" "

TABLE 1 (b)

RESEARCH STATION	AREA	ALTITUDE	RAINFALL	STATUS
National Animal Husbandry Research Station Naivasha	4500ha.	1829m.	730mm.	National Station
Animal Husbandry Research Station Baraton	137ha.	1981m.	1560mm.	Sub-station
Agricultural Research Station Katumani	(650 acres) 273ha.	1700m.	720mm.	National Station (new)
Western Agricultural Research Station Kakamega	112ha.	1580m.	1920mm	Regional Station
National Range Research Station Kiboko	29,000ha.	980m.	615mm.	National Station

TABLE 1 (c)

RESEARCH STATION	AREA	ALTITUDE	RAINFALL	STATUS
Beef Research Station Buchuma	2185ha.	396m.	590mm.	Sub-station
Animal Husbandry Research Station Mariakani	385ha.	180m.	850mm.	Regional Station
Coast Agricultural Research Station Mtwapa	209ha.	15m.	1270mm.	Regional Stations
Nyanza Agricultural Research Station Kisii	80ha.	1800m.	1800mm	Regional Station
Alupe Agricultural Research Station Busia		Not Survayed		Sub-station
Nyandarua Research Station Ol Joro Orok	403ha.	2280m.	1030mm.	Regional Station

TABLE 1 (d)

RESEARCH STATION	AREA	ALTITUDE	RAINFALL	STATUS
Pyrethrum and Horticultural Research Station Molo	160ha.	2550m.	1180mm.	Regional Station
Potatoe Research Station Tigoni	155-193ha.	2230m.	1020mm.	Regional Station
Beef Research Lanet	1612ha.	1700m.	590mm.	Regional Station
Agricultural Research Station Embu	72ha.	1460m.	1230mm.	Regional Station
Cotton Research Station Tebere	80ha.	1160m.	590mm.	Regional Station
Mshabaha Research Station	-NA-	92m.	1210mm.	Sub-station

TABLE 1 (e)

RESEARCH STATION	AREA	ALTITUDE	RAINFALL	STATUS
Kenya Inspection Service for Seeds Lanet		--	--	Regulatory
Office of the Chief Grader and Inspector Mombasa	--	5m.		"
Grassland Research Station Mola (Marindas)	250ha.	2700m.	1200mm.	Sub-station

TABLE 1

OTHER AGRICULTURAL RESEARCH STATION

STATION	AUTHORITY	AREA	ALTITUDE	RAINFALL
Coffee Research Station Ruiru	Coffee Research Foundation		1610m.	1060mm
Matuga Station	Ministry of Agriculture		30m.	1070mm.
Hola Station	Irrigation Board		125m.	460mm.
Tea Research Institute Kericho	Tea Board of Kenya Tea Authority of Tanzania Tea Authority of Uganda	700ha.	2180m.	2120mm
Irrigation Station Ahero	Irrigation Board		1170m.	1280mm.
EAAFRO/EAVRO	N.A.	N.A.	N.A.	N.A.

event that the MOW cannot repair a vehicle, three tenders are required for all repairs over 3,000/-. This requirement cannot be difficult to fulfill because workshops refuse to submit a tender unless they are authorized and paid to dismantle or investigate that part of the car requiring repair to determine the extent of damage, the condition of the parts, the spare parts required, and the labor needed. In addition to the difficultires of just getting the necessary repairs, these regulations make it almost impossible to carry out emergency repairs on sudden breakdowns, accidents and so forth. The impact of these regulations would be less restrictive if vehicles were regularly serviced and if repairs and part replacements were anticipated and planned for. A competent executive officer should be able to do this, and the A.I.E. properly planned and adjusted to accomodate this.

A better system from the point of view of maintaining the vehicles, keeping them operating, minimizing their depreciation, and providing timely repairs, and possibly more cost effective in the short run, is creating the post of a senior mobile mechanic in the Research Division. This is presently under discussion. The senior mechanic would be supplied with a mobile repair unit (a van or small lorry) completely outfitted with equipment to carry out regular maintenance and repair of Division vehicles. The senior mechanic would travel to the stations on a regular schedule to service the vehicles and would be on call to move immediately to a station to carry out short-notice, emergency repairs. As a complement to this position, the Research should have a stock of spare parts located in a Central Research Division workshop. The combination of a central workshop, an inventory of spare parts, and a mobile mechanic unit could possibly overcome the present vehicle, as well as budget regulatory constraints facing the Research Division and its stations.

3. Staff

Shortage of qualified staff combined with heavy staff turnover are mentioned by most observers as the most serious factor limiting the effectiveness of the Research Division. The problem is two-fold, involving the recruitment of good people to start with and their retention after they have been trained and have gained experience.

The Division suffers a constant and serious drain of technical personnel which tends to keep the experienced and better educated people rather few in number as compared with the number of relatively inexperienced people. Three years ago the Division had a staff complement of about 188, of whom 58 have since resigned to take positions with other ministries, the university or private industry. According to the latest figures, the Division now has a senior staff (BSc degree or better) of 133, of whom 102 have BSc degrees and 31 have Masters degrees or Doctorates. An examination of Table 2 shows that the better trained people are rather sparsely distributed among the research stations.

The problem of staff retention is related to the personnel system or scheme of service of the Ministry, and this is discussed at greater length in Section I-D. There is also the constant need for training and upgrading of staff which requires academic as well as on-the-job training and in which external aid has assisted and can continue to assist. Short term assistance involving external aid and the assignment of expatriate scientists to work on specific research programs contributes to the relief of the personnel shortage and also assists with training.

The capability, dedication, obvious interest and hard work of the more experienced senior staff are impressive. There is no question about the competence of these men or that they are doing a good job in spite of the difficultires they may face. The same may be said of their leaders, from the Directors on down, who are constantly striving to improve the service. Unfortunately, these experienced and better trained men are few.

TABLE 2

Senior Kenyan Staff Educational Distribution

Section	B.Sc.	M.Sc.	Ph.D	Total
1. Headquarters	1	4	-	5
2. Entomology Section - NAL	6	3	-	9
3. Plant Patholog N.A.L.	7	1	-	8
4. Soil Survey N.A.L.	8	1	-	9
5.				
6. Seed Testing N.A.L.	1	-	-	1
7. Kitale/Maize Breeding	4	-	-	4
8. Kitale Maize Agronomy	5	1	1	7
9. " Grass Breeding	2	-	-	2
10. " Pasture	4	-	-	4
11. " Seed	1	-	-	1
12. Nyanduara	1	-	-	1
13. Mtwapa	4	-	-	4
14. Plant Breeding Station Njoro	13	1	1	15
15. Molo	3	1	-	15
16. Cotton - Kibos	2 (3)**	-	-	2
17. Embu	1	-	-	1
18. Kisii	3	1	-	4
19. Tigoni	3	1	-	4
20. Thika	5	2	-	7
21. Katumani	4	1	-	5
22. Sugar/Kibos	4 (4)*	1	1	6 (10)
23. Tebere	3	1	-	4
24. Kakamega	1	-	1	2
25. Mombasa CG & I	2	-	-	2
26. Naivasha	7	2	2	11
27. Lanet	1	2	-	3
28. Mariarand	1	-	-	1
29. Kihoga	3	2	-	5
30. Buchuma	1	-	-	1
31. Boraton	1	-	-	1
Total:	102	25	6	133

* Joined in July 1977

**/In Training

B. MANAGEMENT

1. Organization

The Ministry of Agriculture is divided into two Departments: the Department of Agriculture and the Department of Veterinary Services. Each department is headed by a Director of Agriculture who is in Job Group "P". The Division of Scientific Research constitutes a Division within the Department of Agriculture, the rest of which consists of the Extension Service and allied activities.

In spite of its size and the importance of its function, the agricultural research organization thus finds itself essentially subordinate to the Extension Service. Many people feel that an organization of this size, engaged in such a diversity of activities of a highly technical nature, should be elevated to the status of a Department on a par with Extension and Veterinary Services in order to be in a more favorable position to control its own resources and to contribute more effectively to policy making.

The Director of Research is assisted by three Assistant Directors of Research; one for services; one for development (agricultural) research, and one for animal production and research. These officers assume general supervision of groups of experiment stations as shown in Chart 1 and serve also as staff officers to the Director. A proposed upgrading of positions and tightening of this organization is shown in Chart 2. This latter proposal has not yet, however, been approved.

A Biometrics Unit, attached to headquarters, was established in 1970 with one man and has increased to a staff of four. This unit has the responsibility to assure that all research is carried out in accordance with established statistical procedures. Assistance and advice are given to technicians in the design of experiments and the analysis of data and designs intended to be used must be approved by the Unit. Another duty of the Biometrics Unit is to coordinate information for the Division, including the editing of the annual report. A large element of this latter task is to check the validity of the research findings. The Unit also conducts courses and seminars in biometrics in the field as well as headquarters and at the University of Nairobi.

Until recently there had been an expatriate officer attached to the

Director's office whose function it was to assist with Division planning. This planning officer has departed and the post has not been filled. The DOR would prefer to see the position changed to an "Extension-Research Liaison Officer" which would combine planning responsibilities with information liaison. (See Section I-D.)

Large experiment stations are headed by either Directors or Assistant Directors and smaller ones by Senior Research Officers. Some smaller stations may be headed by Research Officers-in-Charge. Sections within large experiment stations are normally headed by Senior Research Officers.

In addition to the research staff, experiment stations have a complement of support staff consisting of executive officer, accountant, storekeeper, secretaries and clerks. These people, if present and competent, may be expected to carry on the day-to-day routine operation of the station.

2. Policy Determination

Broad areas of policy are determined by the Office of the Director of Research in response to developing needs. An example is the growing population pressure in the highland high potential area which is forcing people out into the medium and low potential farming areas. This has resulted in a shift of emphasis to research aimed at those areas and also in an emphasis on research to benefit the small farmer. Similarly, there is a deemphasis of research on some crops such as sisal and pineapple and an increasing emphasis on crops such as sorghum, millets and pigeon pea for the marginal lands and also on range management and ecology for the semi-arid lands. The three assistant Directors of Research participate in policy determination. An expatriate Planning Officer (post now vacant) formerly assisted in this function. To assist in the development of research policy and to maintain close contact with research matters as well as to assist in the day-to-day management of the Research Division, the Director could probably use a small technical-advisory staff attached directly to his office, assuming that personnel for such appointments were available.

An Agricultural Science Research Advisory Committee is proposed by the recently established National Council for Research and Technology.

Chart 1

RESEARCH DIVISION HEADQUARTERS

PRESENT STRUCTURE IN RELATION TO RESEARCH STATIONS

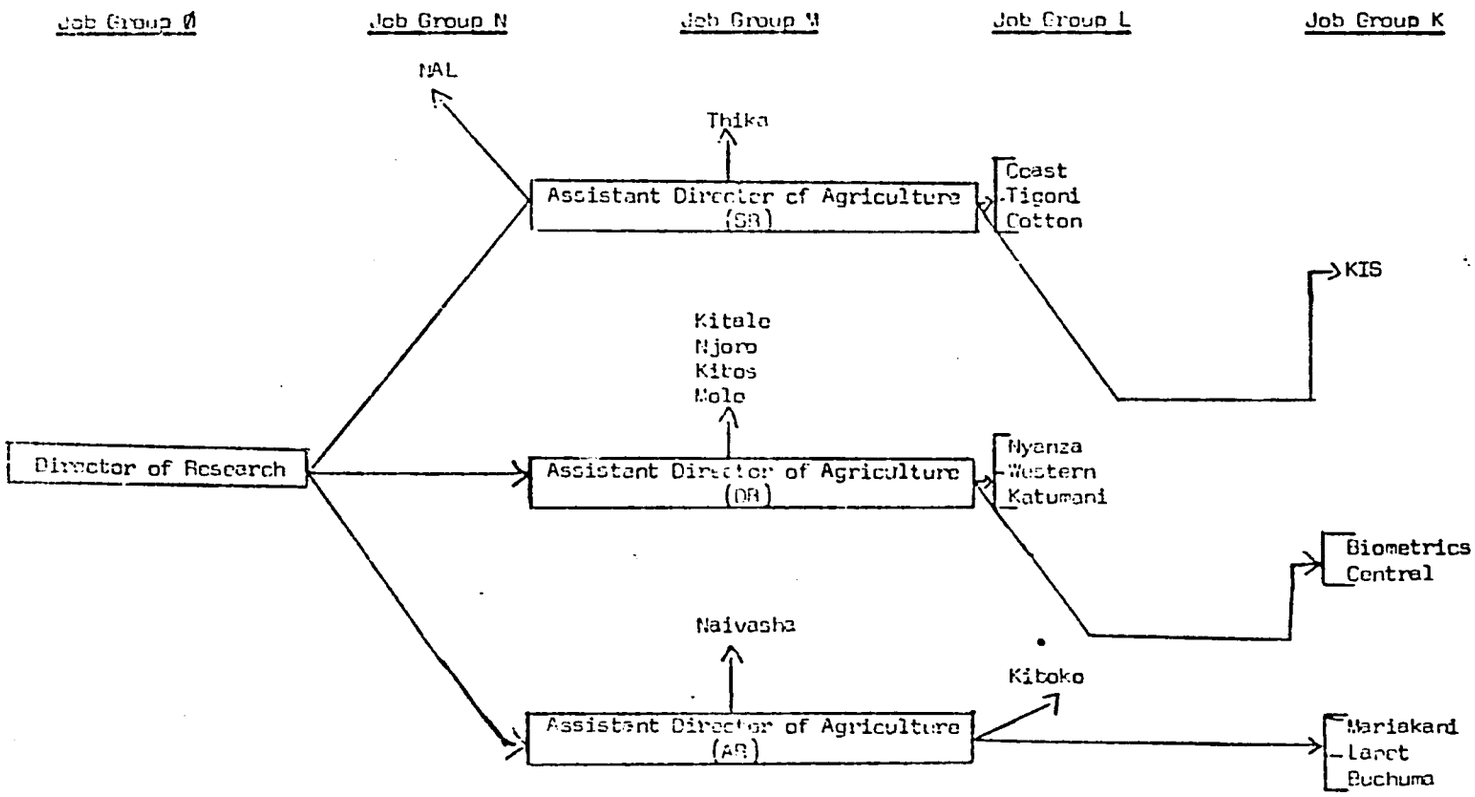
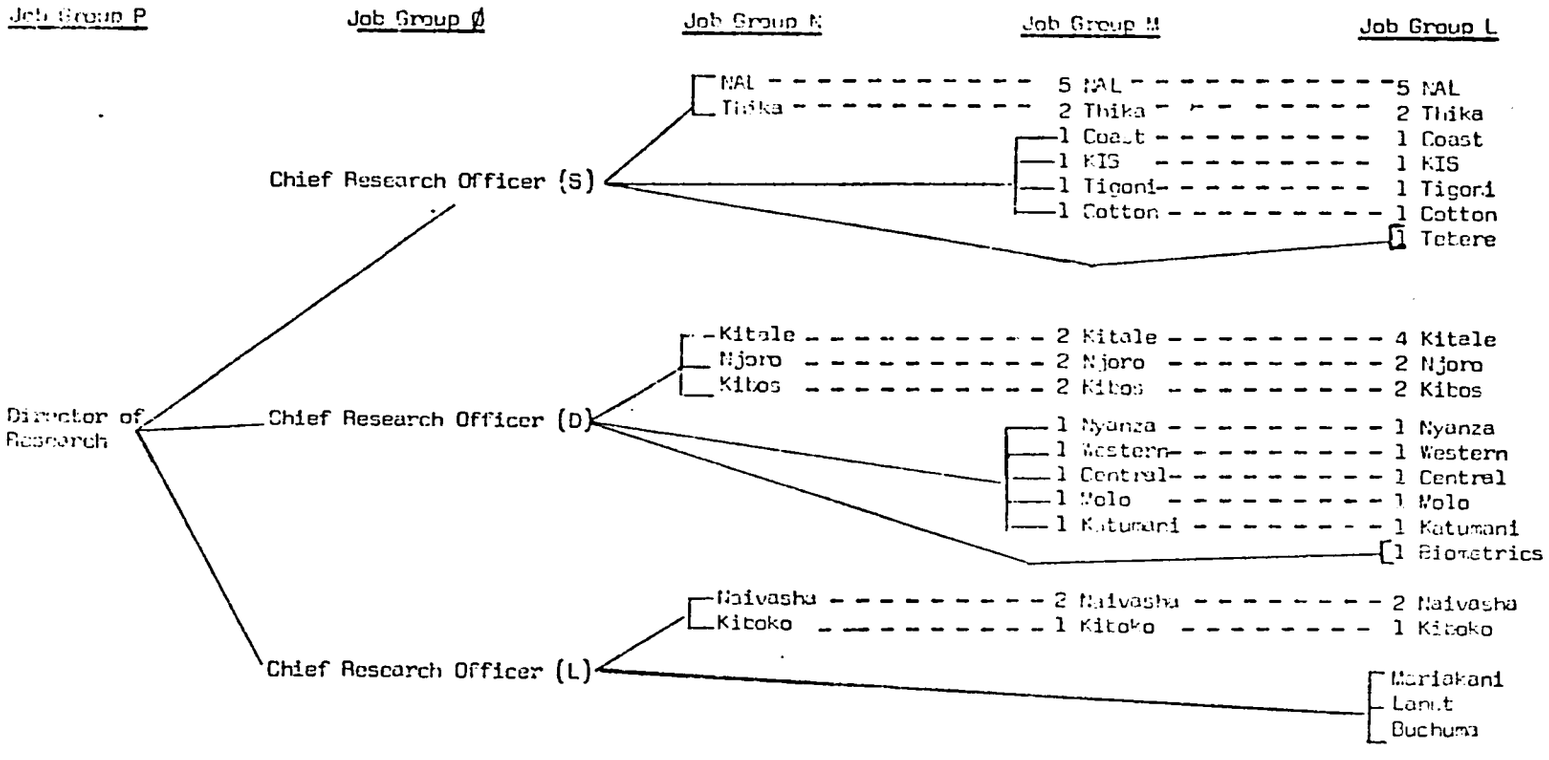


Chart 2

PRESENT ADMINISTRATIVE RESPONSIBILITIES AND PROPOSED STRUCTURE:
RELATIONSHIP BETWEEN HEAD QUARTERS AND RESEARCH STATIONS



This committee would provide advice and guidance to the Director of Research with regard to research priorities, programs and policy. It would also function in the review and evaluation of research projects. This committee has not yet, however, come into being.

3. Planning and Programming

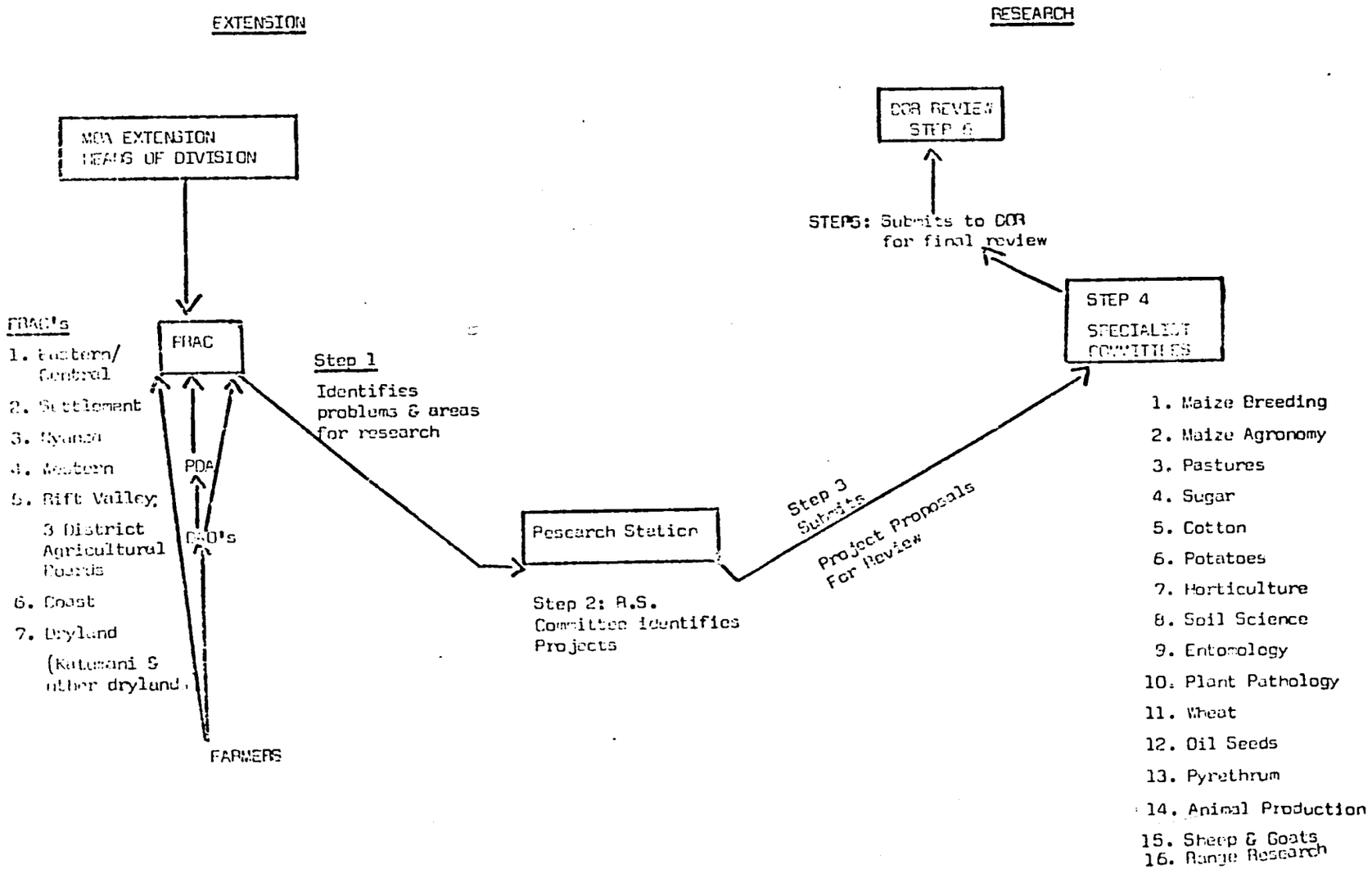
The Research Division uses a yearly planning and programming cycle to identify areas and projects for research. The system is a new one, established in 1973. The system was designed to accommodate the need for greater extension and outside expert participation in research project identification, which apparently was lacking.

The present planning/programming system introduces two new elements into the review cycle, namely the Specialist Committees and the Provincial Research Advisory Committees (PRACs). The Specialist Committees (which are listed on Chart 3) are made up of experts inside and outside of government, including the DOR and his ADAs and the heads of the extension divisions. They are charged with the responsibility of reviewing rationale, feasibility and desirability of research proposals submitted by the national and provincial research stations. The Provincial Research Advisory Committees were established to bridge what was felt to be a "gap" between the needs of the extension and the farmers and the research carried out by the Research Division. The PRACs provide an opportunity for the provincial and district extension officers, as well as farmers, to have an input to the identification of areas and the setting of priorities for research. The PRACs are made up of the Provincial Directors of Agriculture (PDAs), the District Agricultural Officers (DAOs), farmers, and the heads of research stations in the provinces. The heads of the extension divisions (e.g., Head of Animal Production, Head of Land and Farm Management, etc.) and the DOR may also participate in the PRAC discussions. The PRACs (of which there are seven, listed on Chart 3) are expected to meet annually.

Despite the creation of this machinery which is intended to bridge the gap between research, extension, and the needs of the farmers

Chart 3

RESEARCH DIVISION PLANNING/PROGRAMMING CYCLE



the PRACs have come under criticism from some areas of extension because of their apparent failure to meet annually (or more often if required) as expected. This being the case, it is advisable for the DOR and the Research Division to make a greater effort to ensure that the PRACs meet at least once a year, and more often if the need is felt. By the very composition of the PRACs, they should provide an opportunity not only for extension to have an input into research, but also for research to make known its findings to extension.

The planning/programming cycle is diagramed on Chart 3. The initiative for new research projects comes from the Research Stations following their meeting with the PRACs. The Head of Station and his senior staff write up the next year's research program which is then submitted to the appropriate Specialist Committee. The Specialist Committee reviews the proposal placing particular emphasis on the research design and methodology and the technical feasibility of the experiments. The committees make suggestions on the design and feasibility. They may reject a proposal outright if they feel the research is either not needed or beyond the technical capability of the research station. In very few instances is a project rejected outright by the Specialist Committees. A collegial approach to project review is preferred in which the Specialist Committees and the station staff work together to redesign the proposal. Following the Specialist Committee review, the proposal is sent to the DOR for a final review. The DOR in most instances will accept the judgment of the Specialist Committees. At this stage in the review process, the DOR focuses most of his attention on the budgetary implications of the research proposal.

4. Budgeting

Each research station is expected to submit a three year budget forecast to the DOR each June/July. This requires that the heads of station must revise their three-year estimates each year, thus allowing for changes in the station's three-year program like the implementation of a new donor-aided project and so forth. The DOR submits the

three-year estimates to the Principal Finance and Establishment Officer (PFEO) of the MOA who passes them on to the Treasury. The Treasury uses the figures to set budget ceilings for the following three-year expenditures. But because of the annual resubmission of estimates, the Treasury is in a position to revise its ceiling. In effect, the three-year estimates are used for planning purposes. The Budgetary Cycle is diagramed in Chart 4.

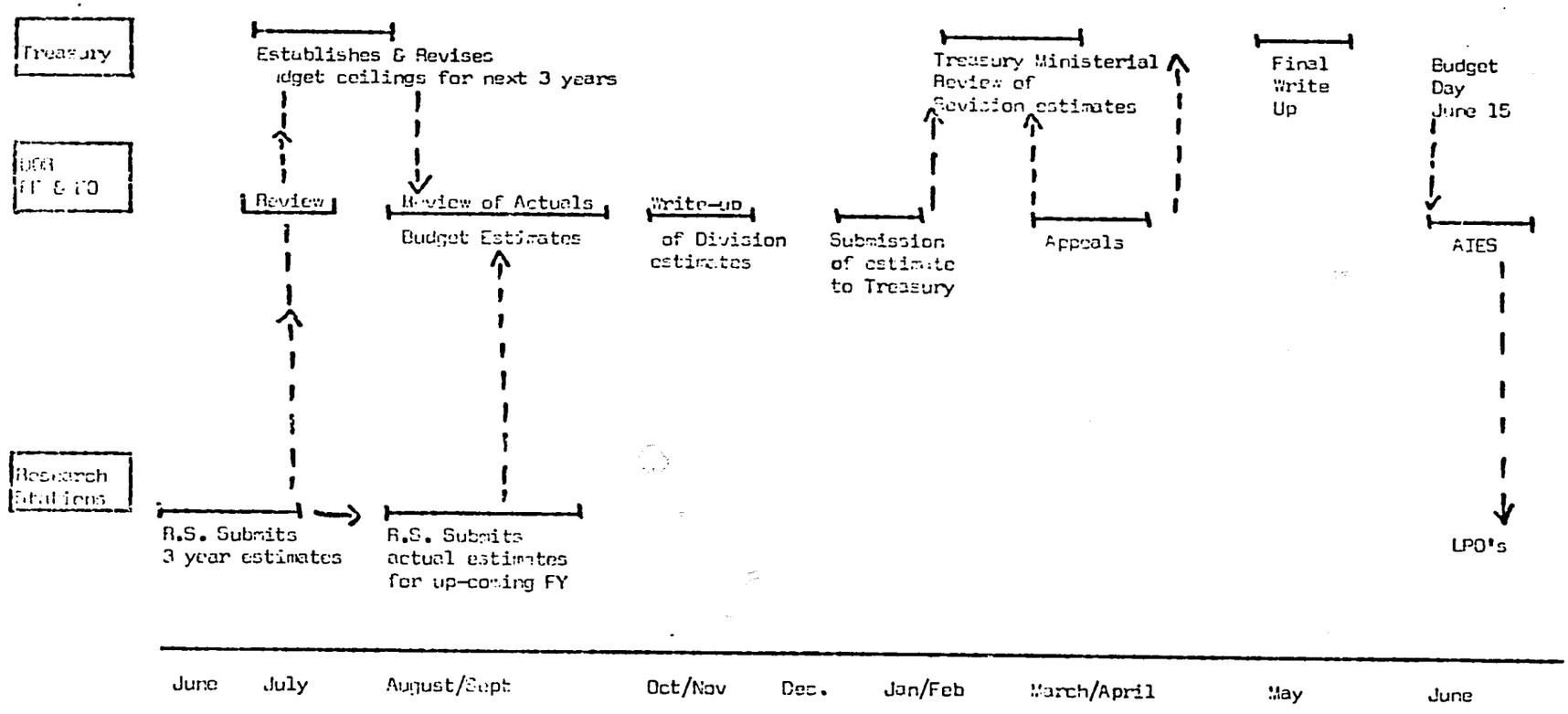
Annual draft estimates are submitted by the heads of stations to the DOR in August/September for the following fiscal year. The estimates include the establishment proposals, i.e , the actual staff requirements, which are different from the three-year staff estimate proposals. The three-year estimates are development estimates vs. actuals. The actual estimates are submitted to the DOR who may cut or add depending on his reading of the station and project requirements, as well as what is feasibly obtainable from Treasury.

The DOR turns the actual estimates over to the PFEO. The PFEO reviews the estimates to be sure that they fit within the Treasury imposed budget ceiling, which are set by Treasury by August. If the actuals exceed the budget ceiling, the PFEO and the DOR meet to assign priorities to the projects and then make their cuts in the low priority projects in order to fit within the ceiling. The PFEO returns with the estimates from all the divisions and writes up the Ministry estimates for the next fiscal year. This exercise generally takes place in October and November with the final revisions made in December for submission to Treasury in January and February. In January/February the MOA's estimates are presented at the Treasury's Ministerial meetings.

The DOR defends his budget independently of the rest of the Ministry. He is accompanied to the one-day review by the Personnel Officer of the MOA and the PFEO. There are two representatives from the Ministry of Finance and Planning, one from the Treasury Department, and one from Planning. The one-day meeting is admittedly a hurried process in which Treasury can either accept or reject the Division's

Chart 4

BUDGETARY CYCLE/RESEARCH DIVISION MCA



budget or proposals in it. If the Treasury rejects the proposals, the Principal Secretary has the right of appeal. Appeals are held in March/April. After the completion of the appeals, all Departments know their budget for the following fiscal year barring salary increases or a national crisis that would alter the estimates.

The budget goes to Parliament on June 15, Budget Day, where it is debated for the next several months. On the 15th of June, all the Ministries receive their budget books. From that day forward until final Parliamentary approval, each Ministry is entitled to one-half of the estimates. The Authority to incur expenditures (AIEs) are prepared and approved by the DOR and the PF&EO. The AIEs, which are the line-item votes, are sent to the heads of stations. They in turn use Local Purchase Orders (LPOs) to incur expenditures.

5. Information

The research stations submit quarterly reports covering progress of research and administrative matters. Each station prepares an annual report in two sections, one administrative and the other research. These are prepared in mimeograph form for immediate distribution to the extension service, other research stations, and other agencies worldwide. The final printed version of the annual report is normally several years late in being printed because of delays in the government printing office. It appears that the annual report may not be printed by a private printing firm but must, by Government Regulation, be printed by the government printing office.

Technical papers giving the results of research are published in appropriate technical journals. These results are also passed to the Information Center of the Extension Service, located at the National Agricultural Laboratories, Nairobi, where the material is edited and rewritten in simple form for use in radio programs, farmers' meetings, and for release in extension bulletins.

The latest information on fertilizer use, weed control, disease and pest control, new varieties, density of planting, and other farm management practices are also disclosed to the extension service and to farmers directly from the experiment stations by means of meetings, field days, and agricultural fairs. The larger stations deliberately organize part of their experimental plantings in such a way that they may be conveniently used as demonstration plots during field days and meetings. The flow of information is illustrated in Chart 5.

6. Personnel Selection and Development

The professional staff are recruited largely from the graduating class of the University of Nairobi from among those graduates holding the BSc degree in either biology or agriculture. Graduates in veterinary science with the degree of BVSc are taken and the University is now also graduating students in entomology.

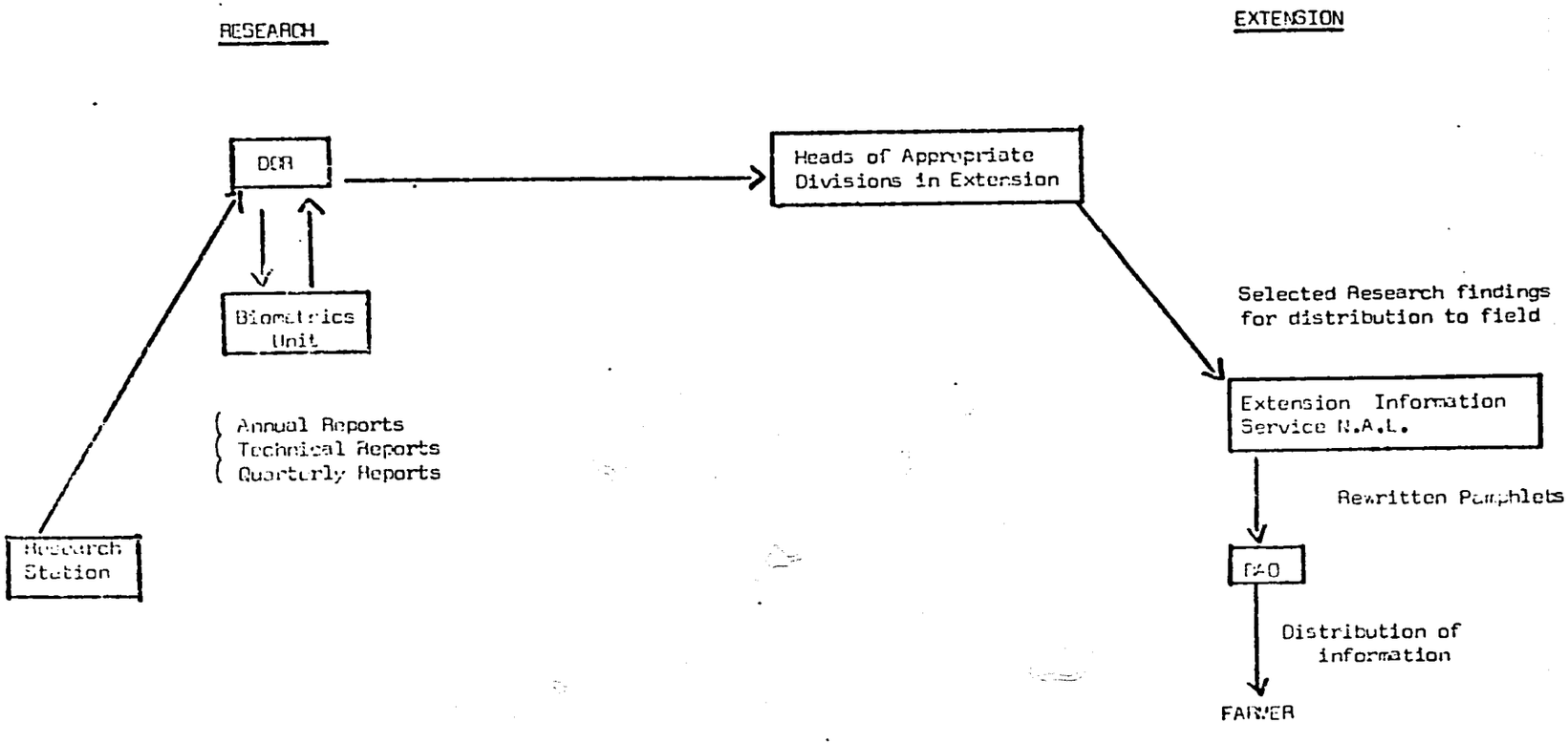
New graduates with the degree of BSc in Biology enter the service at the level of Job Group H; those with the BSc in Agriculture at Job Group J. Considerable further training, both on-the-job and academic, is required before the aspirant can be expected to develop into a competent research scientist capable of independent work. The minimum advanced academic degree the individual is expected to acquire is the MSc, which may be obtained from the University of Nairobi or abroad. While it is theoretically possible for an individual to advance from the grade of Research Officer II to Research Officer I without the MSc degree, in practice this is most unlikely. Scholarship assistance is provided to those individuals selected for advanced study and subjects for thesis preparation are usually chosen which relate directly to Kenyan agricultural problems.

The training and development of staff is a serious problem complicated by the heavy turnover of personnel in the lower grades and the fact that the Division must recruit people at the BSc level who have no research experience or training at all and may not even be seriously interested in research.

Chart 5

SRD

INFORMATION FLOW CHART



A feature important to the training of the research scientist is the attendance at international technical meetings and conferences. These present the opportunity to present papers on the progress of his own research and to hear of the progress made by others. It is an invaluable opportunity to exchange ideas and to keep abreast of progress. The opinion was expressed by many research personnel that greater attendance at such conferences should be permitted.

C. INTERRELATIONSHIPS AND LINKAGES

1. Relationships with Other Research Agencies

The Division of Scientific Research maintains cordial and cooperative relations with the other agricultural research institutions in Kenya, many of which do work which complements that of the Research Division. An example of this is the International Centre of Insect Physiology and Ecology, located on the campus of the University of Nairobi, which does fundamental research on pest management, including basic research on the control of the tsetse fly. The Director of Research is a member of the Board of Directors of the ICIPE.

The Coffee Research Station and the Tea Research Institute of East Africa are industry-supported research institutes set up to take care of the research needs of those industries. The TRI/EA is funded through assessments from the marketing boards of the three East African participating nations (Kenya, Tanzania and Uganda) plus government subventions. The Coffee Research Station is under the authority of the Coffee Research Foundation, a wholly owned board of the Coffee Board of Kenya. The Boards of Directors of these institutes include representatives of the Ministry of Agriculture.

The now defunct East African Community supported several agricultural research organizations. Most notable among these were the East African Agriculture and Forestry Research Organization (EAAFRO), the East African Veterinary Research Organization (EAVRO), and the East African Industrial Research Organization (EAIRO). EAAFRO and EAVRO have cooperated closely with the Research Division and have participated in several research activities of concern to the Division of Research, including plant breeding, soil science, and animal pathology. The quarantine unit of EAAFRO has been of inestimable importance to the Division in facilitating the importation of disease-free plant material. The EAIRO, working on the processing of agricultural products, has been of considerable value to the Kenya coffee industry in matters having to do with the maintenance of quality.

There is an understandable anxiety among the staff members of the three East African organizations since the breakup of the Community. There is deep concern about the possibility of wholesale losses of non-Kenyan professional and subprofessional staff. Such losses could severely disrupt research in progress. There is the further prospect that these staff could not be replaced because of the shortage of qualified Kenyans. There is also concern about the prospects of cutbacks in funding either because of the lack of Kenyan funds or the loss of outside donor aid and donor-supplied expatriate staff. At present, the Government of Kenya is supporting the Kenya-based activities of the three institutes.

Close relations exist between the University of Nairobi and the Division of Research. The University serves as the principal source of new personnel for the Division, and the graduate school provides most training of research personnel to the MSc level. Thesis problems chosen for MSc candidates are selected for relevance to Kenyan agriculture and field experimentation is often done on stations of the Division of Research. Seminars have been held for the training of Ministry personnel in which both University and Research Division personnel participated as leaders. Research personnel have taught classes at the University.

Close ties are also maintained with the International Center for Investigations on Maize and Wheat (CIMMYT) in Mexico, the International Institute of Tropical Agriculture (IITA) in Nigeria, the International Center for Research on the Semi-Arid Tropics (ICRISAT) in India, and the International Centre for Tropical Agriculture (CIAT) in Columbia. Among other things, CIAT and IITA have been sources of cowpea and cassava planting material, CIMMYT has provided support in wheat and maize research, and ICRISAT in sorghum and millet. Very close relations have been maintained with the USDA, AID, FAO, UNDP, IDRC, ODM, NORAD, SIDA, the Canadian Development Organization CIDA, the Ford and Rockefeller Foundations, and with development organizations in Holland, Germany, and Australia.

2. Relations with the Extension Service

The degree of contact and the flow of information between the extension service and the research division varies widely from place to place. Some research stations appear to maintain very cordial relations with their opposite numbers in the extension service and have no problem in maintaining a two-way flow of information. Others report a much less favorable situation. Unquestionably there are problems in this area.

This matter is considered more fully in Section I-D.

D. ASSESSMENT AND RECOMMENDATIONS

The Research Division is performing well within the limits imposed by certain constraints. It has an excellent physical plant, adequate resources both in equipment and money, and is following a policy of shifting emphasis of research priorities in accordance with the changing demands of the economy of the country, as already noted in Section I-B.

The research carried out to date by the Division must be said to have been quite effective in meeting the needs of the country (see Section II). This has been done in spite of certain shortcomings in the system and much credit must be given to the dedicated research officers who have persisted in spite of difficulties.

The following recommendations are offered for consideration:

1. Staffing

Distributed throughout the system of experiment stations are some excellent, well trained and dedicated research scientists. The problem is that there are not enough of these and there are a disproportionately large number of young, recent university graduates lacking in training and experience. The major problem confronting the Division of Scientific Research is one of personnel. Until the personnel problem is solved, the Division cannot be expected to perform at its full potential in spite of the abilities and dedication of its small handful of experienced staff, nor to make the fullest use of its facilities. The personnel problem is one which affects both the technical and support staffs.

a. Technical Staff

The most important problem affecting the performance of the Research Division is that of the attraction and retention of competent technical staff. The Director of the Research Division has prepared a list of 58 research scientists who have resigned from the service since 1974 from a total research staff of 133 (Table 2, page 7). (The number has grown since the list was compiled). These resignations include five plant breeders, 13 agronomists, 12 entomologists, four plant pathologists, three soil chemists, three horticulturists, one soil scientist, one food technologist, two pasture chemists, two physiologists, two range ecologists, two specialists in range research and eight in the field of animal production. The list

includes two PhD's, 23 MSc's, 32 BSc's and one BVSc; four of the holders of BSc degrees also had diplomas for advanced study in their fields of specialization.

This rather high rate of personnel turnover represents a serious loss to the Research Division. It also suggests a high degree of inefficiency since time, effort and money will have been expended in training and experience which must be repeated for the replacements of those who have departed. It is evident that the Research Division is used as a training ground for young graduates who, as soon as they have gained some training and experience, seek jobs elsewhere. The net effect is that the Research Division never acquires any depth of experienced personnel but remains, perpetually, an organization made up to a large extent of trainees.

As an example of how serious the heavy turnover of personnel can be at an individual station, Dr. Ogada, Director of the National Agriculture Research Station, Kitale, described what happened to his professional and sub-professional technical staff during the course of a year. Of a staff of 48, including expatriates, listed in August, 1976, he described the following departures as having occurred during the year or to be effective by September, 1977: 13 resignations, 8 departures for training, 2 suspensions for misconduct, and one person who disappeared leaving no trace. This is a total of 24, or half the station complement and leaves some sections without experienced staff or entirely unmanned. One wonders what happened to the individual, holder of an MSc degree, who disappeared without a trace!

The explanation for this heavy rate of turnover is to be found in the personnel classification system of the civil service which covers all Ministry personnel, and the salary scale, which is too low to be competitive with other agencies and private enterprise. The present classification system for research officers of the Division of Agricultural Research is as follows:

Job	Group	Ø	Director of the Research Division	5 steps
"	"	N	Assistant Director of Research	4 "
"	"	M	Assistant Director or Director of a Major Experiment Station	5 "
"	"	L	Senior Research Officer	6 "
"	"	K	Research Officer I	7 "
"	"	J	Research Officer II	8 "

This is essentially a management system and is not geared to the needs of a research organization since all of the positions except the first two are administrative posts of extremely limited availability. The system lacks flexibility and opportunity for advancement is very limited. The posts of Senior Research Officer, which are available only to Heads of Sections or officers in charge of small experiment stations, are scarce and an officer might wait a lifetime for such a post to become vacant. This, of course, is a major reason for the departure of officers to other agencies and private concerns. It also has the effect, upon occasion, of causing an officer to leave his field of specialization altogether to take the administrative post of Senior Research Officer in a station oriented to a specialty completely different than his own. These factors tend to have a negative effect on the continuity of the research work. The present system does nothing to encourage an officer to continue working in a field in which he has become expert.

A system in which an officer may rise to high salary and status as a reward for outstanding work in his research specialty is needed. The present system imposes a serious bottleneck to promotion and salary increases for research officers and essentially imposes a ceiling to the advancement of most. The Senior Research Officer position should be made non-administrative and there should be more of them. In addition, other non-administrative positions above this should be created. The emphasis should be placed on the research function of the organization and not on management. Officers holding posts in the lower echelons of administration such as section chiefs and heads of small experiment stations, should be expected to continue with their research activities and to assume these administrative duties as an additional burden for which they would receive extra remuneration. Except for the very highest levels of management, these posts could easily be rotated periodically among the senior research personnel.

The personnel system of the Coffee Research Foundation, a semi-autonomous agency, is much superior and could serve as a model for the revamping of the Ministry system. The Scheme of Service for the Scientific Officers of the Coffee Research Foundation includes the following grades:

Job Group	P	Senior Principal Research Officer	6 steps
" "	Ø	Principal Research Officer I	2 "
" "	N	Principal Research Officer II	5 "
" "	M	Senior Research Officer I	5 "
" "	L	Senior Research Officer II	6 "
" "	K	Research Officer I	6 "
" "	J	Research Officer II	8 "

This scheme provides the Research Worker with opportunity for advancement independent of the Management hierarchy. A special allowance is paid to officers having administrative responsibility. Outstanding research scientists may be retained under this system at grades and salaries higher than those received by the administrators of the departments in which they are working.

The University of Nairobi has the following grades:

Professor	5 steps
Associate Professor	4 "
Senior Lecturer or Senior Research Fellow	7 "
Lecturer or Research Fellow	12 "
Assistant Lecturer or Junior Research Fellow	8 "

Responsibility allowances are paid to Heads or Chairmen of Departments, Deans of Faculty, etc. The Research Fellows are not required to teach, but advancement to the grade of Associate Professor is not possible without teaching. There are no positions of Research Professor at the University.

The East African Agriculture and Forestry Research Organization (EAAFRO) has the following scheme of Service for its agricultural research personnel:

CS 14	Chief Research Officer or Director	7 steps
CS 13	Senior Principal Research Officer or Deputy Director	7 "
CS 12	Principal Research Officer	7 "
CS 11	Senior Research Officer	7 "
CS 10	Research Officer Grade I	7 "
CS 9	Research Officer Grade II	7 "
CS 8	Research Officer Grade III	7 "

This scheme, like that of the Coffee Research Foundation, provides for the upward mobility of research personnel throughout and for the retention of outstanding scientists in the higher grades independently of the management ladder.

A new scheme of service for the Division of Research of the Ministry of Agriculture has been proposed (see Chart 2) as follows:

Job	Group	P	Director of Research	5 steps
"	"	Ø	Chief Research Offcier	7 "
"	"	N	Senior Principal Research Officer	5 "
"	"	M	Principal Research Officers	5 "
"	"	L	Senior Research Officer	5 "
"	"	K	Research Officer I	7 "
"	"	J	Research Officer II (trainee)	9 "

This scheme provides greater flexibility than the one now in force but, nevertheless, continues to emphasize administration. The first four grades require no assumption of administrative responsibility, thus providing two more grades for advancement of research personnel than at present. The Senior Principal Research Officer grade is, however, described as being restricted to Directors of National Research Stations, thus imposing a ceiling at that point to the further advancement in grade and pay of officers involved strictly with research, in fact, of almost all of the personnel. There does not exist the possibility, as in EAAFRO, the Coffee Research Foundation and the University, to retain outstanding scientists at high grades outside of the administrative hierarchy. In other words, this proposed system is still management oriented. Since the purpose of the organization is to carry out scientific research, the personnel scheme should be designed to provide incentives and encouragement for the highly trained specialists who perform that function.

An examination of the schemes of service of the Coffee Research Foundation, the University and EAAFRO reveals that precedents already exist in Kenya for the kind of personnel system best suited to the needs of scientific personnel. The minor variations in detail displayed by the schemes of the three institutions, such as the titles of positions and numbers of steps in grade, are unimportant; the important feature is the provision for the advancement to high status and pay for research personnel independently of the management hierarchy.

The following outline for a scheme of service is offered as a suggestion:

Job	Group	P	Senior Principal Research Officer or Director
"	"	Ø	Principal Research Officer or Deputy Director
"	"	N	Senior Research Officer I
"	"	M	Senior Research Officer II
"	"	L	Research Officer I
"	"	K	Research Officer II
"	"	J (or H)	Research Officer III (trainee)

Although the personnel system, or scheme of service, is the most important obstacle to the successful retention of personnel by the Research Division, the salary scale is also a factor. It has been pointed out repeatedly that the Ministry's salary scale is significantly lower than that of the University, resulting in a one-way drain of experienced people. These same critics make the observation that movement of personnel between a research institution and the University can be healthy and desirable, but it must be two-way and on an even footing. Competition in salary with the private sector by the University and the Research Institutions is out of the question, but there should be equality in pay and conditions of service among the latter. The true scholar and research man, will not be lured away to take a higher paying job as a salesman as long as he feels reasonably sure of an interesting and rewarding career in his own field.

The Research Division accepts new university graduates with the BSc or BS degree, but advancement at least to the MSc degree is virtually a prerequisite for promotion. This requirement does not exist in the extension service, making that service appear more attractive to many people.

The fact that the Research Division accepts recent university graduates implies, of course, that it takes in a considerable number of people who have no real "calling" for the career of research scientist but are merely looking for any kind of job in order to get started. The departure or sloughing off of the individuals who have no real conviction or dedication for research is, of course, desirable but it would have been preferable to have avoided hiring them in the first place. Thought might usefully be given to some sort of screening process and probation system.

b. Support Staff.

In order to make it possible for the heads of experiment stations to devote the maximum amount of time to their research programs and the guidance of their research staffs, it is essential that there be a highly competent support staff at the station including executive officer, accountant, storekeeper and farm manager, who can relieve the head of the station of a multitude of administrative details.

The executive officer is the key man in the routine operation of the

station and, in the absence of an effective officer in this position, the head of the station himself is obliged to assume this function and will find most of his time taken up with such duties as procurement, housing, maintenance of equipment, the apportionment of labor and the disciplining of stenographers. The time of the head of the station is too valuable and his talents too scarce to be dissipated in this fashion. Nevertheless, this situation exists in varying degree at several of the stations.

The executive officer must have foresight and organizing ability to a high degree and be able to keep track of a multitude of detail. Efficient procurement for instance, because of the government requirement of bid solicitation for purchases of any consequence depends upon the allowance of ample lead time in ordering materials and supplies to avoid having every purchase become an emergency. Well educated and well trained people are required for this kind of job. These officers should be selected with care, should preferably be university graduates, and should be given additional training in the form of seminars and short courses - something which does not now exist.

Career opportunities for executive officers and other support staff in the Research Division appear to be restricted in much the same manner as those for Research Officers so that the Division finds it difficult to attract and retain good personnel in competition with other organizations, public and private. Efficient administration of the Research Division as well as the optimum utilization of the talents of the research officers in charge of experiment stations require that there be competent and experienced personnel in these positions and adequate incentives including salary and career opportunities, should be provided to attract and hold such people.

2. Upgrading of the Division of Research to Department Level.

The Division of Research has the largest divisional budget in all of government: K£3,279.269 for FY 1977/78. The size and importance of the research operation warrants its elevation to Department status, on a par with the Extension Service and the Department of Veterinary Services. These Departments are headed by Directors of Agriculture (Job Group 'P') so that the new Department of Scientific Research would be headed by the Director of Agriculture for Research (Job Group 'P').

The highly technical and quite diversified work of which the research operation is composed requires that a person experienced in research and familiar with its methods and its problems should have the authority over policy, the determination of priorities, and the allocation of resources. At present, Research is essentially subordinate to Extension and extension-oriented people have authority over these matters. It would seem logical that Research should have the same degree of control over its own destiny as do Extension or Veterinary Services.

The increased responsibility of the Division with regard to its supervision of the research programs of the Kenyan installations of the East African Community is an additional argument in favor of Departmental status. Although these organizations are expected to operate as statutory bodies, and will posess autonomy with regard to their internal operations, the Reserach Division will have the responsibility to review their programs and to assure that they complement the research being carried out in the other stations and conform to the long term needs of the country. The former Community stations are planned to function as institutes, "Centres of Excellence", for the conduct of basic, long term research not feasible to be carried out in the other stations.

3. Preservation and Strengthening of the Agricultural Research Installations of the Former East African Community in Kenya.

The Kenyan government is now funding the agricultural research installations of the defunct East African Community in Kenya and various possibilities for the assurance of their continued existence are under discussion. The survival of these valuable installations, together with the experienced staffs of the institutions, is of the greatest importance and every effort should be made to achieve this. It is very probable that external funding and the employment of expatriate scientists will be required.

The Division of Research hopes that these installations will become "Centres of Excellence" for the performance of basic, long term research not normally possible in the research stations of the Division. This is, essentially, the function these installations have performed in the past, and it is hoped they will continue to perform if after they have become established as Kenyan institutions.

4. Improvement of the Delivery of Information to the Extension Service.

Part of the problem of communication between research and extension may stem from a misunderstanding of the respective functions of research and extension people. It is reported that extension people have complained of not getting immediate help and control recommendations upon the sudden outbreak of an insect pest or similar emergency. This sort of thing is "putting out fires" and is obviously the job of extension and not research. Furthermore, the formula for putting out the fire almost invariably exists and is in the extension office files. Lack of experience and training and unfamiliarity with procedure in the extension office is probably responsible for much of this confusion. The answer to the problem is not, however, to pull the research man away from his job to attend to such emergencies, but to establish an effective alternative mechanism to deal with them.

a. Subject Matter Specialists

The creation of a corps of subject matter specialists responsible for keeping the field extension personnel up to date with the latest information in their fields would help. These specialists should be the persons immediately notified in the event of a crisis and would be in a sound position to handle the "putting out of fires". These officers could be members of the extension service or could be research officers detailed for the purpose. In either case they should be experienced officers holding at least the MSc degree and probably additional specialized training. A basic staff of such specialists should include an entomologist, plant pathologist, soil fertility specialists, agronomist, and animal husbandry specialist.

A logical base of operations for the specialists in entomology, plant pathology and soil fertility are the National Research Laboratories at Nairobi, where the laboratories in these three fields already do a considerable amount of service work. These laboratories provide an excellent training ground for young officers who aspire to careers in these specialties and young aspirants should be required to serve short tours of duty in these laboratories. There is no better way, for instance, to gain experience in the recognition of plant diseases than to work in a busy diagnostic laboratory.

b. An Information Office within the Research Division.

A much criticized aspect of the relationship between research and extension is the flow, or failure to flow, of information from the research stations to the farmer. While Kenya is not unique in having a problem of this kind, it does at times, seem to be unusually acrimonious here. The Research Division puts its latest findings in the form of annual reports published in mimeograph to keep them timely. These are distributed to the Extension Service and other interested institutions. In addition, the results of research are published in appropriate technical journals. The same information is passed on to the Information Center of the Extension Service where it is translated to layman's language for use in radio programs, farmer's meetings and the printing of extension bulletins. This office also handles the updating and reissuing of older extension bulletins.

A complaint has been heard from extension officers that these bulletins and reports are so technical that they, the extension officers, cannot understand them. This is hard to accept because, after all, the primary function of an extension officer is to interpret technical information for the farmer so that he may make use of it! Nevertheless, we can understand how this may happen. Difficulties in the delivery of technical information from the research service to the farmer occur in every developing country and also in the United States. There is no ready-made solution for this which can be applied in toto with the expectation of an immediate disappearance of the problem. The only practical course of action is to work steadily towards improvements.

We believe that the communication problem must be attacted from both sides. The majority of research people, wherever they are located, have difficulty in presenting their findings in terms readily understandable to the uninitiated. They are likely to assume that matters so obvious and clear to them are pretty much understandable to everyone else. Correction of this situation will probably require the establishment of an Information Office in the Research Division to help translate research results into layman's language and to emphasize the salient points of the research and its significance in application. This would tend to get the research results to the Information Center of the Extension Service in a form which would be directly useable by extension agents for their own information,

and which would require less work (with less chance of misinterpretation) by the Information Center to get it to the farmer clients in its ultimate form.

The Research Division's Information Office would also be responsible for the pursuit of a consistent policy for the conduct of field days, seminars, and demonstrations at all research stations and for the maintenance of close liaison with the Extension Serivce. Information Office staff would lend assistance in these matters to the stations when necessary and would be in a position to assure that handouts distributed at field days and talks given at seminars would not be over the heads of the audience. This Office would also assume the responsibility for organizing and convening regular meetings of the Provincial Research Advisory Committees.

This improvement in the communication capability of the Research Division should be accompanied by some beefing up of the Information Center of the Extension Service, if it is not to be a weak link in the communications chain. Success depends on: a) the arrival of the technical information at the center, b) its translation into layman's terms, and c) its eventual delivery to the farmer in the form of bulletins, press releases, radio programs and otehr media. This involves three steps, at any one of which a breakdown could occur. Although our look at the Information Center was perfunctory, we got the impression that this Center was understaffed for the responsible job which it must perform and weak in equipment. In this regard, it was encouraging to learn of impending space and equipment improvements to be made in this Information Center.

5. Distribution of Research Stations and Extension-Demonstration Sites.

The network of research stations and substations of the Research Division is quite impressive and appears to give a very good coverage to the extremely varied ecology of the country. The question arises, however, as to whether there may be too many or too few such sites. Reducing the number of sites would, of course, effect an economy, especially in the distribution of scarce technical manpower. On the other hand, the complaint has been heard from the extension service that not enough sites are available to test and demonstrate the performance of new varieties and cultural practices under all possible conditions and that additional sites are needed, either

on research stations, demonstration farms or the property of the farmers themselves.

One has to select some cut-off point in the establishment of new research stations and substations, based on the return information expected in proportion to the additional effort expended. The Soil and Ecology Mapping Unit of the Soil Survey and Land Use Section of the National Agricultural Research Laboratories has prepared soil maps and ecological analyses of all the research stations and recommendations regarding the degree to which results obtained on the stations may be extrapolated. An eco-climatic analysis of the whole country is expected to be published in 1979, with a draft to be available in 1978. The delineation of climatic zones for the country has already been pretty well accomplished.

The Soil Survey and Land Use Section should be drawn upon for recommendations regarding the need or desirability of new research or demonstration sites. It is understandable that the extension service may find that plantings on a research station serving a given eco-climatic zone may be inconveniently distant from some farmers living in that zone but on the other side of the mountain. The Extension Service itself can, of course, mount campaigns to overcome this and establish demonstration plots of their own on the property of the Farmers Training Centers or in farmers' fields.

6. Counterparts Working with Expatriates.

The counterparts assigned to work with expatriate technicians often are of an inadequate level of training and frequently do not remain long enough ever to take over the expatriate's job effectively when he departs. One hears the complaint, for instance, that a counterpart, fresh out of the University, was assigned, worked for a few months and was then sent off for training. Upon returning from training he was not reassigned to the same project but was posted to another station. At the same time, of course, one hears the complaint that certain expatriates may not be interested in training counterparts because they want to keep the jobs themselves.

The counterpart problem arises largely as a consequence of the personnel problem already discussed. Nevertheless, a definite policy

regarding the selection of counterparts might be desirable. A counterpart should be chosen on the basis of aptitude, interest, and, where possible, prior experience in the field of the expatriate. Care should be exercised to avoid transferring the counterpart in mid tour.

7. Exchange Realtionships with Universities or Research Institutes Abroad.

As a means of speeding the training of staff while simultaneously increasing research output, the possibility of establishing staff exchange arrangements with one or more universities or research institutes abroad should be explored. Such an arrangement would provide for expatriate scientists to work in Kenya and Kenyan personnel to work and study abroad. Such arrangements would be expected to be long term and would probably help to overcome the usual kind of counterpart problem referred to above.

8. Economics Service.

Several research officers expressed the feeling that the services of an economist should be made available to study the costs and returns on investment to be expected from new practices being developed at the research stations. It would not be necessary to assign an economist to every station, but a central service available to all would be desirable. Such a service would be useful in encouraging the adoption of new practices and would also be helpful in anticipating problems in this regard.

The economics studies referred to here have to do with the cost effectiveness of agricultural practices carried out by the farmer or new ones being developed by the experiment stations. It is contemplated that the accumulation of the necessary data for many of these would be incorporated into the original designs of the experiments. This would not be possible in all experiments, of course, but where possible would be of great assistance to the Division's Information Office in preparing useful and timely releases for the farmers and extension officers. It is doubtful that this kind of work would conflict with the activities of the Economic Planning Division of the Ministry.

9. Library Facilities.

Adequate library facilities are a necessity to any research insti-

tution and any research worker deprived of reasonable access to a good library is liable to grow stale. While it is not possible to install a first class library at every research station, sufficient facilities, complete with appropriate technical journals, should be within the reach of all of the personnel in the Division. These might be located at key, strategically located stations. Alternatively, a strong supportive reference system might be developed, but this is difficult.

10. Maintenace of Equipment.

The maintenance of equipment is a serious problem resulting in time-wasting and costly delays at many stations. In the absence of a repair shop on the station, repairs to vehicles, field and laboratory equipment must be made in local shops and require the solicitation of bids for jobs of any consequence.

Repair shops, staffed by competent mechanics and stocking supplies of spare parts should be maintained at the major stations. The possibility that repair ships at the major stations might perform work for the minor ones should be explored. Alternatively, a central facility might be installed in Nairobi with mobile maintenance units travelling out to the stations.

II. NATIONAL RESEARCH PROGRAMS

Kenyan agricultural research policies and programs were strongly oriented to export crops and large farm agriculture during the colonial period. This orientation continued into nationhood both from need and inertia but began to shift towards smallholder emphases. This shift appears to be accelerating and is reflected in regional emphases, types of crops, budgetary allocations and statements of Division leadership. The shift of emphasis is most pronounced in the increasing interest in the semi-arid lowlands and dry rangelands, which is largely in response to the increasing migration by smallholders to these less productive areas from the densely populated highlands. Unquestionably, the increasing emphasis on crops suitable to these areas—short-cycle maize, sorghum, millet, pigeon pea, etc.—will benefit small farmers.

It is not possible to establish in quantitative terms how much research now benefits the small farmer or how much he will benefit in five years. One should note that all research on maize, grain legumes, vegetables, sorghum and millet, sesame, sunflower, pyrethrum, pastures and forages, and large and small livestock is of benefit to the small farmer or can be if properly handled by the extension service. It is clear that the policy of the Division is to work in behalf of the smallholder and the trend to implement this policy is evident—being propelled by population pressures and the economic needs of the country.

The agricultural research carried out by the Research Division receives good marks for having improved agricultural production in both products for export and food and other goods for internal consumption. Kenya is at the moment in the happy position of having to worry about a surplus, instead of a deficiency, of maize and is able to make donations for famine relief to other countries. Although favorable weather during the past year is a factor in this bounty, the hard work of the maize breeders, agronomists and entomologists during the past several years must be given a fair share of the credit.

The national maize research program, operated from the National Agricultural Research Station, Kitale, has produced hybrid and composite varieties of maize suitable for the various climatic regions of the country and incorporating high yield, drought resistance and improved protein quality. This program has received considerable support from outside agencies including USAID, both bilaterally and through EAAFRO, and from the United Kingdom. The maize program is, of course, of importance to both the large producer and the small farmer. The highly successful program for the control of insects on the crops and in grain storage, carried out by the Entomology Section of the National Agricultural Laboratories at Nairobi, has contributed to this success.

Maize is preferred as a food grain over sorghum in Kenya and short season, drought resistant varieties suited to semi-arid areas have been developed. Population pressure, forcing people out of the high potential agricultural areas and into the low rainfall and semi-arid areas has, however, aroused new interest in sorghum and millet. There is resistance on the part of the small farmer to the use of these grains because they have become accustomed to eat maize and would prefer to plant maize under conditions unfavorable to the setting of a crop rather than sorghum or millet which would be certain to set a crop.

Short season sorghum of improved protein quality is being studied, and the possibilities for new varieties of this plus short season pigeon peas for the semi-arid regions as well as millet and cowpeas are being viewed optimistically by the investigations at the Arid Lands Station, Katumani, Machakos. This station is making a start towards the study of mixed cropping with these grains.

The use of maize and sorghum as feed for pigs and poultry are both being investigated, although there is resistance to the use of maize as animal feed because it is considered to be an exclusively human food. The use of maize silage and fodder and sugarcane refuse has been successful in feed lot production of beef, as has the use of sorghum. This activity has been under the guidance of the Beef Research Station, Lanet,

with the objective of trying to utilize industrial and agricultural wastes in beef fattening. Pyrethrum waste has been successfully used, but the opinion here again seems to be that the future lies with sorghum, both for the high and medium productivity areas because sorghum yields much better than maize. Two-thirds of the high grade beef produced in the country is now produced in feed lots, and there has been some export. This, however, represents only 20% of the total beef production.

The national wheat program, conducted by the Plant Breeding Station, Njoro, which received support from the Canadian foreign assistance organization, CIDA, as well as from CIMMYT, is another successful project which has vastly improved food production and has earned an international reputation in stem rust research. The ten-year association with CIDA, ending in 1976, resulted in the development of the station and training of the staff. The station also has responsibility for barley research (for malting), triticale research, and the coordination of research on annual oil crops; sunflower, soybeans, rape, groundnuts and sesame. This latter is a comparatively new undertaking and involves a number of outstations covering various climatic zones: Thika, Mtwapa, Kisii, Kakamega, Ol Joro Orok, and Katumani. Sunflower is the most promising oil crop at the moment because of its adaptability to a wide variety of climates. Rape is proving valuable in rotations with wheat and barley. Sesame is taking hold on the coast. Sunflower has many diseases and the pathology department needs strengthening to deal with these. Very little work has been done with soybeans or groundnuts.

The edible legume research project, headquartered at the Horticultural Research Station, Thika, has concentrated on beans; snap beans for canning from 1971 to 1976 and dry beans since that date. Now the project is expected to expand to consider other grain legumes, including cowpeas and pigeon peas. This project is financed by Holland and includes three expatriate scientists. The agronomy of the crop is being studied as well as breeding and selection and a beginning is being made in mixed cropping

studies—intercropping of beans and maize. Work is going forward also on pest control, and the breeding work considers disease resistance, plant habit, protein content, and seed color.

The Horticulture Station conducts research and coordinates area trials on vegetable crops and is working on vegetable seed production. In this work, diseases and insects are a big problem, and additional pathology and entomology staff are needed. Fruit and nut crops are also a responsibility of the station, and work with avocados, grapes, sweet orange and passion fruit is in progress at Thika, also macadamia, which is undergoing clonal trials for nut quality. The passion fruit is very popular and the juice industry is well established. Fresh pineapple production is being studied and is considered a small farmer possibility. A temperate fruit project at Molo, involving apples, pears, and plums and a tropical project at Mtwapa involving mango, cashew and coconut are also coordinated from Thika.

The National Animal Husbandry Research Station, Naivasha, maintains a herd of pure-bred Friesian cattle for intensive daily research on small farmer problems and is working on the development of cattle for different ecological situations in the country. It also maintains the National Sahiwal Stud as a service to farmers. Exotic breeds, such as Friesian and Jersey, are recommended for the high rainfall areas, the Sahiwal for the 25 in. ± area, and the small Zebu and local variants for the marginal areas. Friesian x Sahiwal F. crosses have been found to be tougher, more resistant, more efficient, and to outyield either parent in milk production. The station also maintains a pig unit, conducting feeding trials with by-products at present, and is starting a poultry unit. A sheep section is working on sheep production in high rainfall, high altitude areas and studying the effects of sheep on water run off.

The Range Research Station at Kiboko is the station which is concerned with the dryland range management and ecology, including the interaction between the natural wildlife of the area and domestic

cattle management activities. This is a relatively new activity and not much range management work has been initiated beyond a study of methods to recover range from brush. Range hydrology is a field the station would like to get into but has not as yet. A study of various trees, shrubs and cacti as forage is in progress. Perhaps the most interesting work in progress is the attempt to domesticate zebra and eland, including studies of their feeding habits and water consumption. Little progress seems to have been made with the zebra, but the eland appears very promising. Eland have been domesticated and under study in Russia for some time, and the technician in charge of this project studied there. The eland is a browser, though it will graze, making it an efficient converter of the scrubby range. It produces highly nutritious milk of 10-14% butter fat and 7-8% protein, which is said to have therapeutic properties. It also produces good meat.

An interesting project in progress at Thika, which is aimed directly at small farmers and cottage industry, is the mulberry-silkworm project which is assisted by Japan. Four selections of mulberry are under study for leaf production, and pilot plan equipment is in operation for the production of cocoons and the spinning and weaving of the silk. A cooperative has already started the development of a cottage industry.

There are three research programs in cash crops for export: those in pyrethrum, coffee and tea. Pyrethrum research is conducted at the Pyrethrum Research Station, Molo, a station of the Research Division; coffee research is carried out at the Coffee Research Foundation station at Ruiru, an agency financed largely by the Coffee Foundation; and tea research is carried on by the Tea Institute of East Africa, Kericho, and financed by the Tea Board. Of these, pyrethrum is produced almost entirely by small farmers and is a very important crop for the small farmer in the highlands. Kenya is the world's leading producer of pyrethrum. Two-thirds of Kenya's coffee is produced by small farmers, but they account for only 50% of the crop, indicating that the larger

growers are making the best use of the latest technology and that there is a shortfall in the delivery of technology to the small farmer. Kenya is considered to produce the world's highest quality coffee. Tea is produced almost exclusively on large estates and is of little interest to the small farmer.

On balance, it would seem that agricultural research is being directed to those areas where it is needed and is doing its job of improving the production of food and other products for the people. Shifts in emphasis from crop to crop and area to area can be noted in accordance with the changing demands of the country. The performance of the Division has been very good in spite of the problems already noted. The correction of those problems should result in an increase in research as well as a considerable improvement in efficiency.

There is an evident shortage of experienced personnel in several disciplines, notably plant pathology and entomology and horticulture. It appears that there are no specialists in weed control at all in the Research Division. Even agronomists and plant breeders, the disciplines present in greatest abundance, are looked upon as being really in short supply. These shortages relate to the personnel problem already discussed and a correction of that problem, combined with a strong training effort, will be required to bring about a permanent solution to the shortages and an improvement in the service.

III. NON-RESEARCH FUNCTIONS

A number of activities are carried on within the Division of Agriculture Research which are only marginally involved with research. Being technical in nature and related to one or more of the research disciplines, they are to be found in the Division largely because they developed there in response to an expressed need and the advisability of moving them is questionable. These include various service and regulatory functions.

A. SERVICE FUNCTIONS

These include the soil test laboratory, which produces soil analyses and fertilizer recommendations, and the diagnostic work involved in identification of plant diseases and pests and control recommendations produced by the plant pathology and entomology laboratories. These latter are, of course, involved in research work and are only part-time service organizations.

In addition, there is the Kenya Service for Seeds at Nakuru. This organization, relatively new, is charged with the certification of seeds and plant material, varietal description and the determination of trueness to type of named varieties.

B. REGULATORY FUNCTIONS

These are two in number: the Office of the Chief Grader and Inspector at the port of Mombasa and the inspection service for cargoes of vegetable and fruits departing from the airport at Nairobi. Both of these are now operated by the entomology section at the National Agricultural Research Laboratories. To these might be added the Pesticide Residue Analysis Laboratory, also operated by the entomology section.

While it is true that these activities do take up the time of research people, one suspects that the services are performed better

by the research organization than they probably would be if transferred elsewhere. In addition, the diagnostic function of some of the laboratories constitutes a desirable training activity for the research personnel, as well as an early warning system of the advent of diseases and pests.

It is claimed that a relatively small amount of effort is expended on most of these activities and that they return valuable information in exchange. In all probability these services are better left where they are.

IV. FOREIGN DONOR ASSISTANCE

A. FOREIGN DONOR SUPPORT FOR AGRICULTURAL RESEARCH

Since 1971, foreign donor assistance has supported some 15 research projects in the areas of cereals and grains, grass breeding, pasture research, maize agronomy, oil seed production, sorghum and millet development, and coffee breeding (see Annex 2). A partial accounting of these projects indicates donor assistance amounting to well over K£1.16 million, over 50 man-years of technical assistance, and 54 man-months of training. (Note: donor expenditure, technical assistance and training figures were not available for all projects.) A partial accounting of the Government of Kenya contribution shows GOK budgetary support amounting to over K£1.18 million.

The Research Division has identified and submitted proposals for several projects which for various reasons have not yet found a donor willing to support this research. Most of these projects are considered high priority like the dryland farming research and the cereal and oilseed research and should be given serious consideration by the donors.

A number of other projects are under negotiation or have been recently approved by the donors and the Treasury. These include projects in irrigation, sugar cane, coconuts, and passion fruit.

The Research Division has identified as one of its highest priorities the need for donors to support training of research staff. Donors seem to prefer to include training as a component within a specific research project and not as a separate project. This is not always the most desirable, needed or advantageous approach to enhance the Division's research capabilities from the viewpoint of the Research Division. A variety of skills are needed which are transferable between projects and without which the Division cannot properly function. Yet unless these skills are tied to a specific project

with a research target in mind, donor training support is unlikely. From the viewpoint of the Research Division, building up the overall skills and capabilities of the research staff is as much required and should have equal status with developing new research projects.

B. PROJECT DESIGN AND SELECTION OF DONOR AGENCY

The initiation of a foreign donor aided research project comes from the Research Division and not from the foreign donor as is the case with some categories of donor aided development projects. The projects are conceived and designed by the Division with a foreign donor in mind, but it is not until the project is written up into a proposal format and expert Kenyan opinion on the project is sought that a donor agency is approached for consideration of assistance to the proposed project.

The non-involvement of the prospective donor in the initial conception and design of research projects carries with it costs and benefits. The major cost with this design approach is that man-hours and money are devoted to project preparation with no guarantee of donor support. The proposal could be rejected by the prospective donor. This happened in the recent case of a Research Division initiated research project on drylands farming which the Division considers to be high priority. The prospective donor, the Federal Republic of Germany, rejected the project as being too broad, expensive, with the roles of the various participating donors not identified as clearly as they would have liked. This might have been avoided had the donor been involved in the early stages of project design and preparation. The major benefit of this design approach is that the Research Division can set its research priorities and projects without interference by the prospective donor.

The Research Division selects prospective donors according to the donor's areas of specialization and expertise. The Dutch, for example, are selected for seed inspection because of their long-time involvement and work in this area. The Germans are favored for

research development work and the British for basic research, particularly research that is short-termed with immediate benefits and a broad application that extends beyond the borders of Kenya.

C. FOREIGN DONOR TECHNICAL ASSISTANCE AND TRAINING

An integral part of most foreign donor assistance projects is the requirement for local counterpart training. It is expected that the foreign technical assistance staff member undertakes the training of the local counterpart during part of the former's tour, followed by a formal training period for the local counterpart. The Research Division officials cited many instances where the counterpart training concept has failed to provide the expected on-the-job training except in those cases where the local counterpart is a fully trained and experienced research person. The Division officials fully accept the difficulty faced by many foreign research personnel of training fresh university graduates with little or no practical research experience in techniques and theories with which they, the foreign staff, are fully conversant. This dimension of the counterpart training problem can be overcome if the Research Division staff are fully trained at the Masters level before being attached to a donor sponsored project. In addition to the difficulty of training fresh staff, the Division officials feel the counterpart training concept breakdown because foreign research officers do not treat their work foremost as a transfer of skills and knowledge, rather they tend to view their work only as a piece of research they are responsible for starting and implementing. In these instances, of which there are several in the Kenya donor supported research record, the foreign research staff completely ignored their training responsibilities. Additionally the Research Division should be insistent that a donor agency fully understands its on-the-job training responsibilities and fully embodies those responsibilities in the project agreement. As a complement to the project agreement language, provision should be made for systematic

evaluations of the training capabilities and dispositions of the donor project foreign research staff on a semi-annual or annual basis; and provision for terminating a foreign research staff person for failure to undertake counterpart training.

V. PRIORITY AREAS FOR FUTURE RESEARCH

A. BROAD AREAS OF RESEARCH IN NEED OF STRENGTHENING

1. Range Management and Ecology

Range management in the arid lands, including the interaction of domestic cattle and indigenous wildlife, is a field which the Research Division has already begun to investigate. Facilities have been established and some projects initiated. The range management research staff comment, however, that the program is just beginning.

Considering the large areas of arid and semi-arid lands in Kenya and the importance of the indigenous wildlife as well as the cattle industry to the economy of this country, this is a field of research deserving of a very strong effort in which external funding and expatriate scientists may be required.

2. Drylands Agriculture

This, too, is a field in which the Division of Research has work in progress. The population pressure in highly productive areas, forcing people to move into the marginal lands, is creating a demand for information on the techniques for the management of such lands. The dryland areas require methods devised especially to fit their needs; it is not sufficient merely to try to adapt procedures used in the highly productive, high rainfall areas. The investment of greater effort in this area is needed and will probably require external funding and employment of expatriate scientists.

3. Coastal Agriculture

The coastal area has been traditionally neglected but is now coming into importance because of increasing population. The Research Division has a number of research activities in progress there, but it is felt

that a greater effort is needed. This effort will, in all probability, also require outside support and expatriate scientists.

4. There are several fields of study in which the ranks of the Division are very thin or in which there is a total lack of personnel (Weed Science). A training program to correct these deficiencies should be mounted. The most obvious deficiencies occur in the following fields:

a. Plant Pathology

b. Entomology

c. Horticulture and Economic Botany, including the investigation of potentially valuable indigenous plants

d. Weed Science

B. SPECIFIC RESEARCH PROJECTS RECOMMENDED FOR INITIATION OR STRENGTHENING

There are several lines of investigation which could be very valuable to the economy of the country. Of these, two are mentioned here in which work is already in progress but which need strengthening and two which have not been initiated. All of these projects are ones in which foreign assistance and training programs would be desirable.

1. Nitrogen Fixation in Grasses

The study of nitrogen fixation in the grasses is a field which should be included in the program of the Research Division. This is a relatively new development first discovered by Dra. Johanna Doberheiner of the Instituto de Pesquizas e Investigacão, Kilometer 47, Rio de Janeiro, Brazil, but now being pursued by several other institutions including Rothamstead Experiment Station, the University of Florida, and the University of Nebraska.

Nitrogen fixation has been demonstrated in sorghum, millet, wheat and maize, as well as various species of pasture grasses. The capability to form the necessary association with the nitrogen-fixing bacterium is genetically controlled by the host plant so that this capability can probably be bred into existing varieties.

From the point of view of reducing agricultural production costs and the conservation of energy, few factors could be more important than economy in the use of nitrogenous fertilizer, both for crop production and range management. Of course, this kind of economy is of interest to all farmers but of special interest to the small farmer of limited financial resources.

Because of the diversity of soil types and climate and the large number of crops concerned, research in nitrogen fixation by grasses organized as a national program would be appropriate. Expatriate assistance and training may be obtained from the institutions referred to above and perhaps others.

2. Mixed Cropping and Multiple Cropping

The purpose of studying mixed cropping is to attempt to systematize and do better something that the small farmer has been doing traditionally for a long time. Basically, the objective is to work out the optimum mix of crops, the optimum proportions of crops in the mix, and the optimum density of stand required to obtain the maximum total yield from a piece of land. The effect of the mixture on the incidence and spread of diseases and insects as well as the effects of the presence of one crop plant on the growth of another have to be studied.

Multiple cropping—following one crop with another on the same piece of ground the same year—is also an interesting and potentially very useful line of investigation. This can be of importance to both large and small farmers, while mixed cropping would be of interest primarily, though not exclusively, to small farmers.

Some work is already in progress in the Research Division in these fields, though of limited scope. Here again a national research program to cover the various climatic zones in the country would be most productive.

3. High Quality Protein Sorghum

Emphasis on the development of lines of sorghum having the high lysine or high quality protein characteristic for the various climatic zones of the country is highly recommendable.

The Research Division has already made excellent progress in the development of superior maize composites and hybrids with high quality protein and is well aware of the existence of the same quality in sorghum. This is an important nutritional factor which would be of special value to the small farmer who depends on his crop to feed his family as well as to the large or small grower who wishes to use the grain to feed non-ruminant livestock. The avoidance of the need to purchase and feed protein concentrate by using grain of high protein quality should effect a substantial economy in the cost of producing non-ruminant livestock.

4. Rice Research

Rice is a crop on which no research at all is being done in Kenya. With increasing interest in the crop and areas in the western part of the country and on the coast where it appears possible to grow it economically, both rainfed and flooded, the Research Division should be involved in rice research at least in a minor way so as to be able to anticipate problems.

A N N E X A

BUDGETARY TABLES

TABLE 1

MOA & RESEARCH DIVISION BUDGET

(EXPRESSED IN KENYA £)

1977/78

	Gross Estimates	Appropriation In AID	Net Estimate
MOA			
Recurrent	18,791,571	3,816,071	14,975,500
Development	27,858.982	1,633,970	26,225,012
Total	46,650,553	5,450,041	41,200,512
Research Div.			
Recurrent	2,201,995	398,000	
Development	1,475,274		
Total	3,677,279		3,279,269

TABLE 2

Research Division Budget

Expressed in Percentage

I	Research Division Budget (Gross) as % of MOA Budget	7.8%
II a)	Reserach Division Development Budget as % of total MOA Development Budget	5.2%
b)	R.D. Recurrent Budget as % of Total MOA Recurrent Budget	11%
c)	R.D. Appropriation in and as % of total MOA Appropriation in aid	7.3%

TABLE 3

MCA AND RESEARCH DIVISION

BUDGETS EXPRESSED

IN PERCENTAGES

	MCA	RESEARCH DIVISION ONLY
Recurrent Expenditures as % of Total Budget	40%	55%
Development Expenditures as % of Total Budget	60%	45%
Appropriation In Aid as % of Gross Budget	11.6%	10%

TABLE 4

A. Research Division Budget 1977/78
(Expressed in K£)

	Recurrent	Development	Appropriation in aid *
Range Research	148,579	36,670	18,000
Animal Husbandry	408,336	182,396	166,000
Hqts.	73,478	-	10
Crop Research	1,431,178	438,695	153,740
Soil Plant & Seed Insp.Reg. Serv.	140,414	156,690	60,250
Grain Storage & Handling	-	660,833	-
Total	2,201,985	1,475,284	398,000

* Appropriation in aid: receipts from sales & contributions excluding external donor receipts.

** Net = Gross Budget (Recurrent & Development) minus appropriations in aid.

B. Research Division Budget 1977/78
Expressed in Percentages

	As % of Total Recurrent	As % of Total Development
Range Research	6.7%	2%
Animal Husbandry	18.5%	12%
Hqts.	3.3%	-
Crop Research	64.9%	30%
SP & SI Reg.Services	6.3%	11%
Grain Storage & Handling	-	45%

TABLE 5

The percentage of a Research Division Sections' budgets devoted to:

	Recurrent Expenditure	Development Expenditures
Range Research	78%	22%
Animal	57%	43%
Crop Hqts.	100%	-
Crop Research	74%	26%
Soil Plant & Seed Inspector	34%	66%
Grain Storage & Handling	-	100%
	55%	45%

TABLE 6

Budgetary Costs covered by 1977/78
Appropriations in aid e.g. receipts
from sale of goods, equipment, production

Section	Appropriation in Aid	As % of Section Budget
Range Research	18,000	9%
Animal Husbandry Research	166,000	28%
Crop Development Hqts.	10	-
Crop Research	153,740	8%
Soil Plant & Seed Inspection Regulatory Service	60,250	20%
Total	398,000	10%

TABLE 7

1977/78 Development Expenditures
By Project or Research Station*

Development Estimates Details

Vote	Item	1976/77	1977/78	External Receipts
211	Kibara Range R.S.	-	21,330	-
211	Buchuma		15,340	-
224	National Animal Husbandry Research, Naivasha		31,510	-
"	West, Coast, Nyanza, Eastern & Rift Valley Provinces		80,000	-
"	Beef Industry Development		33,890	29,880 FAO/UNDP
"	Alupe Animal R.S.		11,010	-
"	Sorghum & Millet Development Project (UNDP/FAO)		25,986	-
232	Horticulture Research Project		14,500	UNDP/FAO
"	Potatoe Research Unit		8,410	
"	Sugar Research S/Kibos		20,020	
"	Plant Breeding Station/Njoro		53,010	
"	Posture Research Project (UK)		54,600	
"	Maize Agronomy Project Kitale		20,000	-
"	Rice Research Project		--	10
"	Dry Bean Project			41,420
"	Oilseed Project		5,000	10
"	Barley Research Project		4,000	
"	Dryland Farming Research		88,210	
"	Irrigation Research		82,600	5027 + 10 Dutch
"	Pest Control Research		71,905	64,905 + 0 Dutch
"	Marketing Development Project (UNDP/FAO)		-	

Vote	Item	1976/77	1977/78	Extend Receipts
233	Seed Unit		69,000	
"	Soil Survey Projects		57,980	
"	Pesticide Residue Project		14,710	
"	Chief Grades & Inspection		10,000	
238	Grain Storage Project Research		36,833	
"	Grain Storage & Handling		550,000	416,000 ± 500,000 UK
"	Potatoe Storage & Marketing (Germany)		36,390	
"	Passion Fruit Research Project		37,610	

* 1976/77 estimates are provided to clarify includion of certain projects which do not have 1977/78 financing or only a very small portion of total costs.

TABLE 8

Forward Budget Estimates (Expressed in Kenya £)

1978/79

	Recurrent	Development	Appropriation In Aid	Total (Net)
Range Research	257,232	193,982	23,500	427,714
Animal Husbandry	468,633	299,900	175,000	593,533
Crop Dev.Hqts.only	90,500	-	10	90,490
Crop Research	1,838,686	814,352	173,510	2,479,578
Soil Plant & Seed Inspection Reg. Services	180,374	186,770	65,600	301,494
Grain Storage	-	177,866	-	177,866
Total	2,835,425	1,672,820	437,620	4,070,625

1979/80

	R.	D.	A.I.A.	Total Net
R.R.	266,950	97,982	26,000	338,932
A.H.	532,474	219,735	179,500	572,709
Hqts.	100,700	-	10	100,690
C.R.	2,064,184	559,799	181,510	2,442,473
SP & SI Reg. Service	197,450	100,508	68,050	229,908
G.S.	-	151,571		151,571
Total	3,161,758	1,129,595	455,070	3,836,283

	R.	D.	A.I.A.	Total Net
Range Research	289,500	104,367	28,000	365,867
Animal Husbandry	589,540	215,552	182,000	623,092
Hqts.	107,000	-	10	106,990
Crop Research	2,223,385	543,735	190,010	2,577,110
Soil Plant & Seed Inspection Reg. Services	231,350	76,150	71,000	236,500
Grain Storage	-	142,463	-	142,463
Total	3,440,775	1,082,267	471,020	4,052,022

TABLE 9

Forward Budget Estimates
Expressed in Percentages

Percentage of Research Division Section Budgets Devoted to.

	% of Total Recurrent (Gross)	% of Total Development (Gross)
1978/79		
Range Research	9%	11.5%
Animal Husbandry	16.5%	17.9%
Hqts.	3%	-
Crop Research	64.8%	48.6%
SP & SI Reg.Sect.	6%	11.1
Grain		10.6
1979/80		
Range	8.4%	8.6%
Animal/Husbandry	16.8%	19.4%
Hqts.	3.1%	-
Crop Research	65.2%	49.5%
SP & SI Reg.Serv.	6.2%	8.8%
Grain Storage	-	13.4%
1980/81		
Range Res.	8.4%	9.6%
Animal Husbandry	17.1%	19.9%
Hqts.	3.1%	-
Crop Research	64.6%	50.2%
SP & I Reg.Services	6.7%	7.0%
Grain Storage	-	13.1%

TABLE 10

East African Community Agricultural Research Organizations 1976/77 Budget (Expressed in T£)

Organization	Recurrent	Development	Receipts	Net
E.A.Agriculture & Forestry Research Organization (EAAFRO)	645,715	210,640	97,670	758,685
E.A.Vet.Research Organization(EAVRO)	411,790	150,000	117,685	550,025
E.A.Industrial Research Org.	120,645	150,000	13,565	257,080
Joint Services Division EAAFRO & EAVRO	122,105	-	860	121,245

A N N E X B

FOREIGN DONOR SUPPORTED AGRICULTURAL RESEARCH PROJECTS

Foreign Donor Supported Agricultural Research Projects

Project Title	Donor Agency	Life of Project	GOK Contribution	Donor Contribution	Research Areas	Location	Donor Approval Yes/No 1 Negotiations
Bean & Grain Legumes Research (extension of 1970-75) Agreement	Netherlands	1975/80	£119,450	113 m.m./T.AG. & £30,170	Mexican 142 Pigeon Peas & other legumes	Thika - N.H.R.S..	Yes
Cereal & Oilseed Research (extension of 1970/74 Agreement)	Canada	1974/77	£251,000	72 m-m/TA £36,000 (IDRC) + 6 scholarships	Small grains & rapeseed	Njoro N.P.B.S.	No
Coffee Breeding Project	Netherlands	1971/76			Introduce new varieties of Arabian Coffee	C.R.F. Ruiru	Yes
"	"	1975/78	£[illegible],750 + 30 m-m fellowships + £9[illegible]75	30 m-m/TA 30 m-m fellowships	Continue coffee breeding work	CRF Ruiru	Yes
Horticultural Development Program	International Coffee Organization	1971/74	-	£383,000	1) Horticulture diversification 2) Training in Horticulture 3) Advisory Service 4) Research	Nationwide	No Negotiations at FAO Yes
Dryland Farming Research	F.R.of Germany	1977/80	K£238,830	a) 188 m-m/TA b) 72 m-m/Training c) £285,000	Dryland Farming Technology Management Production Research Structure	Katumani & Eastern Prov.	No

Project Title	Donor Agency 1 Country	Life of Project	G.O.K. Contribution	Donor Contribution	Research Areas	Location	Donor Approval
Dryland Farming Research	Germany FAO/, ICRISAT	1977/80	KE142,000	a) Germany £638,000 b) 72 m-m/Training	Dryland Farming: Technology, Management, Production Research, Structure.	Katumani & Eastern Prov.	No
Grass & Seed Production (continuation)	FAO/NORD	1976/77	£31,310	£121,560	Grass/Pasture for arid/semi arid loads	NARS/Kitale & its sub station	Yes
Grass Breeding Project (continuation)	" "	1975/78	£65,935	75 m-m/TA + £12,250	"	"	Yes
Grass Breeding Project	"	1971/75			"	"	Yes
Maize Agronomy Research extension	U.K.	1974/77	£71,505	128 m-m/TA £18,000	Maize Agronomy	NARS Kitale & & sub-stations	Yes
Oil Seed Improvement	Italy	1974/77	£113,032	60 m-m/TA 48 m-m/Training £9700	Continue Sunflower breeding; Soya bean	NARS - Kitale N.H.R.S. - Ruiru	No
"	"	1972/74	£ 51,142	48 m-m/TA + £2900	"	"	Yes
Pasture Research	UK	1970/77			Pasture research for for animal production requirements	NARS - Kitale	Yes
Field Pest Control	Netherlands	1977/78	£102,980	73 m-m/TA + £43,000	Research on pest control	Mtwapa, Kibaa N.A.L./NG	No Donor
Seed Unit extension	"	1977/79 (extension of project 1971/76)	£476,410	193 m-m/TA 24 m-m/Training £352,650	Operation of the KIS Kenya Insp.Service for seed regulatory	Nakuru- KIS	Yes

Project Title	Donor Agency 1	Life of Project	GOK Contribution	Donor Contribution	Research Areas	Location	Donor Approval
Sorghum & Millets Dev.Project	UNDP/FAO	1977/78 (2 years)	£146,499	£147,939	Research on high altitude millet/ sorghum + orange varieties	Nakuru/Lanet	Yes
Kenya Soil Survey	Netherlands	1972/76 (5 years)	£151,050	£445,000	establish a soil survey unit	N.A.L./Nairobi	Yes
							Yes
Irrigation & Drainage		1977/81					Yes
Sugar Cane Research	IBRD						Yes
Coconut Research							Negotiation
Passion Fruit and Vegetable	FHO	1978/80	NA	NA			Yes