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HUMAN RESOURCES DEVELOPMENT

PROJECT DESIGN

FOR

NATIONAL AGRICULTURAL RESEARCH

KENYA

Submitted to: Mission Director
USAID/KENYA
Nairobi, Kenya

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Acronyms

BSc	Bachelor of Science Degree
CIMMYT	Centro Internacional De Mejcramiento de Mais y Trigo
Diplomate	Holder of a Diploma
GOK	Government of Kenya
ISNAR	International Service for National Agricultural Research
IARC	International Agricultural Research Center
IARS	International Agricultural Research System
ILRAD	International Laboratory of Research on Animal Diseases
JKC	Jomo Kenyatta College
KARI	Kenya Agricultural Research Institute
MOALD	Ministry of Agriculture and Livestock Development
Moi U	President Daniel arap Moi University
MSc	Master of Science Degree
NARS	National Agricultural Research System
Parastatal	
PhD	Doctor of Philosophy Degree
REDSO/ESA	Regional Economic Development Services Organization, East and Southern Africa, Nairobi (USAID)
UNBI	University of Nairobi
USAID	United State Agency for International Development

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EXECUTIVE SUMMARY

This report contains:

1. An analysis of scientific manpower training needs for agriculture and food crop production in Kenya.
2. A ten year program for training and development of scientists and managers of agricultural research in Kenya.
3. A feasibility analysis of placement prospects, availability of trainees, impact of sending research officers for training and trainee retention probabilities.
4. Implementation plans for alternative levels of funding, with number of trainees, by category and estimated costs, 1987-1996.

The present level of training of the manpower assigned to Kenyan agricultural research is grossly inadequate to provide the scientific information and technology necessary for increasing food production needed in the year 2000 and beyond. At present rates of growth the population of Kenya will double in 20 years. By 2025 it will be about 80 million compared with 20 million in 1986. The GOK task force on the National Agricultural Research Plan summarizes the situation very succinctly as follows:

1. "Inview of the fact that a postgraduate degree, at least to the MSc level with some training in research processes and methodologies, is regarded as prerequisite training for a research officer, it is clear that the majority of research scientists in the system are inadequately qualified. This situation is also aggravated by the fact that most of those scientists are assigned to functions for which their basic training has not in any way oriented them."
2. "... many of the technical officers and technical assistants as designated are in fact not adequately or specifically trained for the functions they perform or are expected to perform."
3. Training is also needed in "... skills of serving officers in the areas of organization and management of research, research planning and programming, research methodologies and skills development, monitoring and evaluation procedures and research results communication."

Of the 43 plant breeders assigned to all food crop production in 1986, not one has a PhD degree and only 10 have an MSc degree. Of the 281 total research officers in food crop production there were only 5 with PhD degrees and 80 with

MSc degrees. A discipline by discipline assessment of those needs indicates that there should be 155 PhDs and 126 MScs. BScs do not meet the minimum requirements for crop production research.

In sessional paper #1 of 1986, the GOK says "food security remains a major objective of the government. The country will continue to be self sufficient in maize, beans, potatoes, vegetable, milk, beef and meat products, and other foods" and "first and foremost, research must be concentrated on these crops and those kinds of farms on which the strategy depends most heavily. The first priority is maize and especially maize grown by smallholders."

To meet these goals requires an increase in maize production of 109% by the year 2000; wheat, by 80%; horticultural crops by 169% and milk by 125%.

To build the food crop production research scientists staff to needed levels would require training an additional 224 PhD's and 259 MSc's. This amounts to 22 PhD's and 25 MSc's per year for the next decade.

The present annual rate of training for scientists in agricultural research is about 8 PhD's and 30 MSc's. By 1996, this rate of training would put about 322 MSc's into the total Kenya National Agricultural Research System. But it would put about 83 PhD's into the system, less than half the number needed for food crop production alone.

The GOK/ISNAR and other reports have analyzed total training needs for Agricultural Research. In addition to training research personnel for MSc and Ph.D. degrees, Dr. James Matata, NARS, indicated that motivating and stimulating training experience is needed for research managers and research scientists who need continuous updating and motivation.

The following training program for agricultural research scientists and managers and technicians is needed. It calls for:

1. Short term training for 40 research station heads and administrators at U.S. agricultural experiment stations.
2. Training 100 PhDs in the United States.
3. Conduct of PhD thesis research in Kenya on Kenya problems, and funding the major professor to come to Kenya to help the student organize his/her research project.
4. Training 54 MSc's at the University of Nairobi.
5. Providing 40 2nd year MSc thesis research fellowships to CIMMYT.

6. Short term training for 40 research station heads and administrators at U.S. agricultural experiment stations.
7. Training in research methodology fundamentals for 450 BSc's and Diplomates at Egerton College.
8. Training in research analysis and write-up for 400 junior research officers at Egerton College.
9. Bringing one leading scientist per year to Kenya to conduct a program for 30 Kenya scientist on the cutting edge of some important field of agricultural research.
10. Sending 6 agricultural research scientists per year for 6 months to work alongside U.S. agricultural research scientists in their program.
11. Providing 2 visiting professors per year to the University of Nairobi to supplement the teaching program in scientific disciplines where the UNBI curriculum needs more strength.
12. Providing on-the-job training for technicians responsible for repair and maintenance of scientific equipment.

The faculty of the college of agriculture (crop production) at the University of Nairobi is an underutilized national resource. In 1984-85, it consisted of 63 people for an undergraduate enrollment of about 400 and 150 postgraduate students. Of these 63, 43 had PhD degrees, 25 of which were from excellent Land Grant Universities in the United States. The crop science department consisted of 17 faculty members, 14 with PhD's, 11 from the U.S.

Recurrent cost funding is needed to take advantage of this rich national resource, to provide needed agricultural research for Kenya, to provide a research based training program for post graduate students and to incorporate the University of Nairobi more effectively into the Kenya National Agricultural Research network.

The MSc program of UNBI is a taught program and except for the fact that it has sometimes taken 5 years for a student to complete his degree is well accepted as to quality.

The PhD program at UNBI is not a taught program; consequently numerous people in NARS suggest that students be sent to the United States for their PhD training.

At the levels outlined above, the training component of this program would cost 22 million dollars total for a 10 year period. By reducing the training elements of the program by about 40% total cost can be reduced to about $15 million. This level of training would be adequate to cover the development of managers and scientists needed for an excellent maize and sorghum research program during the next 10 years.

In 1986, there were 192 people with MSc degrees in the total NARS. With this number plus 30 new MSc's being added to the NARS annually, there would seem to be an adequate pool of MSc's from which to draw PhD candidates.

Removal of scientists from the ongoing program to send them for training is inevitable if they are to be trained. The impact of this removal can be reduced to a minimum by 1) having PhD candidate do their thesis research in Kenya on problems of Kenya Agriculture, 2) filling positions vacated by MSc's who go for PhD training with MSc's have just returned form training.

With present pay scales in the NARS, it is unlikely that trained PhD's can be retained in the system. Rather than not send people for PhD training in this situation, however, it would be advisable to raise the pay scale for PhD's in research high enough to keep them in the positions for which they are trained.

The MOALD has well defined and well run system for recruiting and approving candidates for training.

INTRODUCTION

This report was prepared in fulfillment of Contract No. PIO/T 615-0510-3-60016, National Agricultural Research Project Design — Project Paper, Human Resources Development Analysis.

The major assignments for the report were:

1. Review, analyze and update the 1982 GOK/ISNAR Study assessing the human resource development needs associated with the public sector; analyze similar requirements in the private and college/university sectors.
2. Utilizing the analysis of human resources development requirements, prepare a ten-year plan for training the scientific, managerial and technical support staff in agricultural research, both in the private and public sectors.
3. Analyze placement prospects for trainees, impact of removal of trainees on the research program, likelihood of retraining trainees in the NARS and relative merit of training options.
4. Provide an implementation plan for training to be financed by the project, including administrative structure and a projection of all costs of the program.

In preparation of this report it was kept in mind that the heart of any agricultural research system, whether it be in Kenya, the United States, or in any other country, is the training and excellence of its scientific manpower.

- Well educated in basic scientific knowledge and agriculture.
- Well trained in the scientific method and technique.
- Dedicated to solving the problems of farmers and the improvement of agriculture.
- Committed to professionalism and rigorous analysis.
- Willing to work together to pool brainpower and the knowledge of various disciplines to find the solution of problems.
- Enthusiastic about the importance of their mission and their contributions to their fellow man.

The best trained people for modern scientific agricultural research are those with PhD degrees, many with post doctoral experience. The second best trained are those with MSc degrees who have not yet achieved the level of scientific knowledge or analytical and technical skills of the person with a PhD degree. People with Bachelor of Science degrees are not trained to do the

scientific research required for modern agriculture, even at the applied on-farm trial levels. Therefore, the MSc degree is the minimum qualification for a person to begin to do scientific research. People with less training than this are important in a research system too. They include the technical officers and technicians who must do the day-to-day work of research, so that the scientist does not have to spend his valuable time doing routine tasks normally performed by these people.

In considering a manpower development program it is also worthwhile to keep in mind that there are many kinds of "training." There is training to do singular tasks such as measuring yields or repairing a piece of equipment. There is training to do more complex tasks such as laying out a test plot, following instructions for planting it, observing it during the growth season and measuring the results. This training may take several weeks or months. Also, there is the training of scientists. This involves an educational process in which the "trainee" must learn a complex set of laws and principles and develop the knowledge and skill necessary to conceptualize and solve complex and difficult problems. Training of managers in the knowledge and skill necessary to lead and manage successful research programs is also crucial to the success of the research program.

An important factor to keep in mind in the development of a training program, is that the comparative advantage of the United States in the manpower training and development for agricultural research is greatest in the training of PhDs and in the management of both the research system and individual research stations. It so happens that these are the areas of manpower training and development most needed by the Kenya NARS.

PRIORITIES OF THE GOVERMENT OF KENYA FOOD PRODUCTION AND AGRICULTURAL RESEARCH

In Sessional Paper No.1 of 1986, "Economic Management for Renewed Growth," the Kenya Government says, "Kenya's food security remains a major objective of the Government. The country will continue to be self-sufficient in maize, beans, potatoes, vegetables, milk, beef and meat products, and other foods. The biggest challenges will be to intensify maize and milk production so that output can keep pace with rapid population growth without a large increase in land devoted to these commodities."

In its policy statement on research it says, "First and foremost, research must be concentrated on those crops and those kinds of farms on which the strategy [for food security] depends most heavily. The first priority is maize, and especially maize grown by small holders." Another high priority is dairy production, which must more than double on existing land in order to maintain self sufficiency to the end of the century. "Research needs for these products plus wheat, horticultural and beef production, must be fully funded before other research programs are pursued." Also, "A program of training and upgrading research staff will be undertaken and the terms of service modified to promote the best researchers and retain them in Government service."

Programming requirements call for doubling maize, milk and wheat production by the year 2000 (Table 1). Beef consumption is expected to triple and horticultural crop production to go up more than 150 percent. (See tables 4 and 5.)

Table 1. Agricultural Production Targets for Kenya to the Year 2000.

Item	Base Years	Production	Target in 2000	Percent Increase
Maize (1000 MT)	1981-84	2,100	4,400	109
Wheat (1000 MT)	1981-84	214	400	87
Milk (Mil. Ltrs)	1984	1,600	3,600	125
Beef & Small Stock (1000 MT)	1984	199	420	121
Horticultural Crops (1000 MT)	1984	809	2,180	169

Maize is the most important single agricultural commodity in Kenya, taking into account its contribution to different national development objectives. It has been estimated that maize contributes more than 19 percent of total agricultural production, 25 percent of agricultural employment, 78 percent of total cereal consumption, 44 percent of total energy needs, and 32 percent of total protein requirements in Kenya. Alone, maize occupies more than 20 percent of the medium-to-high potential land and makes up 25 percent of agricultural employment. It is the most important sources of income and subsistence for the rural poor, and any changes in the level and efficiency of its output will inevitably have a major impact on overall national development.

Research emphasis as indicated by expenditures of funds will be:

Crops		56.3 percent
Maize	14.1	
Wheat	4.3	
Sorghum/Millet	3.4	
Potatoes	4.1	
Cotton & Other Fibers	4.9	
Soil & Water Management		6.3
Animal Production (included Pasture and Fodder)		24.6
Animal Health		12.5
		100.0 percent

Note that maize gets only 14 percent of agricultural expenditures for research but that it constitutes 19 percent of total agricultural production.

Tables 2 and 3 summarize national agricultural research priorities and disciplines on which research is to be concentrated to meet food production needs.

Training Priorities of the GOK. The task force report pointed out that to achieve the above production targets urgent emphasis is needed on research training as follows:

For Maize and Horticultural Crops. Increased training in all research disciplines to the highest possible levels. This means providing PhDs to provide research leadership in each discipline, MSc's to scientifically test

new information and technology under farm conditions in all areas. It means upgrading the knowledge and skills of all personnel to the highest possible levels necessary for performing their responsibilities. Special emphasis should be placed on training for maize breeding.

For Wheat. Training to the highest level for wheat breeders and agronomists and their support staff.

For Milk and Beef Production. Training to the highest possible level, PhDs, MScs and support personnel for all areas of research, breeding and genetics, nutrition, and herd management.

For Livestock Disease Control. Training for PhDs in Immunology.

Soil Fertility. Training research officers in soil physics and soil chemistry necessary for soil fertility research.

Irrigation & Drainage. Training agricultural engineers to MSc level in the design and development of irrigation systems for small holders.

TABLE 2 NATIONAL AGRICULTURAL RESEARCH PRIORITIES

COMMODITY/PROBLEM AREA	RELATIVE VALUE %	RELATIONSHIP TO NATIONAL GOALS					POTENTIAL		EXPECTED PAYOFF		
		GROWTH	EQUITY	FOOD SEC.	TRADE	NUTRITION	MARKET	RESOURCES	MAGNITUDE	PROBABILITY	TIME SCALE
		PRIORITY I									
Maize	13.2	High	High	V.High	High	High	Good	Medium	Large	High	Medium
Wheat	2.1	Low	High	High	Med.	High	Good	Medium	Med.	Low/Neg.	High
Sorghum/millet	1.5	High	High	High	Low	Med.	Low	Large	Large	High	Med.
Beans/grain legumes	3.3	High	High	V.High	High	High	Good	Large	Med.	Med.	Med.
Fruits and vegetables	6.5	High	Med.	Med.	High	High	Excellent	Small	Med.	Med.	Med.
Root and tuber crops	8.1	High	High	V.High	Low	High	Good	Med.	Large	High	Soon
Dairy production	16.3	High	High	High	High	V.High	Excellent	Med.	Med.	Med.	Med.
Beef production	11.8a	High	High	High	High	V.High	Excellent	Large	Med.	Med.	Dist.
Seed technology	?	High	High	High	Med.	High	Good	Med.	Large	High	Med.
Coffee	21.6	High	High	NA	V.High	NA	Excellent	Med.	Large	High	Dist.
Tea	11.9	High	High	NA	V.High	NA	Excellent	Med.	Med.	Med.	Dist.
Soil and water man.	?	High	High	High	NA	High	NA	Large	Large	Med.	Dist.
		PRIORITY 2									
Rice	0.5	Low	Med.	High	Low	High	Low	Small	High	Med.	Med.
Oil seed crops	0.36	High	High	High	High	High	Good	Large	Large	High	High
Cotton	0.4	Med.	Med.	High	High	High	Good	Med.	Med.	Med.	Med.
Sugarcane	3.6c	High	High	Med.	High	Med.	Good	Small	Large	High	Med.

Table 2 Continued

OMMODITY/PROBLEM AREA	RELA-TIVE VALUE %	RELATIONSHIP TO NATIONAL GOALS					POTENTIAL		EXPECTED PAYOFF		
		GROW-TH	EQUITY	FOOD SEC.	TRADE	NUT-RITION	MARKET	RESOURCES	MAG-NITUDE	PROBA-BILITY	TIME SCALE
ree crops	0.4d	High	High	Med.	High	Med.	Good	Med.	Med.	High	Dist.
yrethrum	0.4	Med.	Med.	NA	High	NA	Good	Small	Med.	Med.	Dist.
nge and pasture	?	High	High	High	Low	High	Low	Med.	Med.	High	Med./Dist
eep and goats	11.8e	High	High	High	Med.	High	Good	Small	Med.	Med.	Med.
od technology	?	High	Med.	High	Med.	High	Good	Med.	Large	High	Med.
. Engineering	?	High	Med.	High	Low	Med.	Low	Med.	Med.	High	Dist.
PRIORITY 3											
her small grain cereals	0.4f	Med.	Med.	Med.	Low	High	Good	Small	Med.	High	Med.
her fibre crops	1.1g	Med.	Low	NA	High	NA	Good	Small	Med.	Med.	Med./Dist
roforestry	?	Low	High	Med.	Low	Med.	Low	Small	Large	High	Med./Dist
rticulture	?	Low	Low	NA	High	NA	High	Small	Med.	Med.	Med./Dist
ultry/pigs	?	Low	Med.	High	Low	High	Good	Small	Med.	Med.	Med./Dist
mels	?	Low	High	High	Med.	High	Med.	Med.	Low	Low	Dist.
troduction and germ asm conservation	?	Low	High	High	Low	High	Low	Small	High	High	Med./Dist

tes: (a) Includes sheep and goats
(b) Relates to groundnuts and sunflower
(c) Negative value because of high government subsidy
(d) Information available only for cashew nuts
(e) Same as (a)
(f) Information relates to barley only
(g) Information available for sisal only

Table 3 AREAS OF RESEARCH CONCENTRATION BY COMMODITIES/FACTOR

COMMODITY/FACTOR	FACTOR OR DISCIPLINE																							
	Breeding	Agronomy	Entomology	Pathology	Nematology	Physiology	Soil chemistry	Agric. chemistry	Soil microbiology	Soil physics	Weed science	Seed technology	Tech. design & testing	Agric. engineering	Agroclimatology	Soil fertility	Hydrology	Nutrition	Management	Animal Health	Pasture agronomy	Range geology	Meat science	
Maize	***	**	**	*		**	**				**			*	-	-	-	-	-	-	-	-	-	**
Wheat	***	**	*	**		*					**		***		-	-	-	-	-	-	-	-	-	**
Sorghum/millet	***	**	*	**								*		*	-	-	-	-	-	-	-	-	-	**
Upland rice	GE	**	*	*							-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beans	GE**	***		**	**		*				*	**	*											**
Green pea	***					*																		
Sunflower	**	***	**	*			*				*													*
Rapeseed	**	**	*	**			*				*													*
Irish potatoes	***	***		***							*	*	**	**										*
Sweet potato	GE	*	*																					**
Casava	GE*	**	**	*								*												
Vegetables	**	***		*	*	*	*				**	**	*											*
Fruits	**	***	**	**		*	**				**	**	**											*
Cashew nuts	*	**	**	**			*																	**
Floriculture	-	**	*	*			*				*	**												*

NEEDED LEVELS OF TRAINING

Current Levels, NARS

At the time of independence, 1963, most of the scientists in the Kenya Agricultural Research system (KARS) were expatriates. Most of the expatriates are now gone and the GOK is in the process of building its own agricultural research system consisting of Kenyans. This transition is only partially achieved and much more training of scientific manpower will need to take place to build the Kenya NARS to its needed level of competence.

The MOALD Task Force on the National Agricultural Research Program proposal reported that there were 469 total agricultural research officers in the Kenya NARS in 1986. Over half of this number (56%) were inadequately trained to do scientific agricultural research even at the most elementary level with little or no training in the methods or skills of scientific research. The BSc is the current entry level into the National Agricultural Research System. BSc's are currently being fed into the system primarily through training at the University of Nairobi. In four more years, there will be an additional supply of BScs coming from Egerton College.

There were only 16 research officers with the PhD degree among these 469 research officers. As the system of research and education has evolved to date, there has been little emphasis placed on training of PhDs to do scientific research. There is apparently an attitude that the PhD does not do research. He only does administration. The pay scale for research officers, even at the senior levels apparently is not high enough to encourage people to get a PhD and do research.

Many constraints of the system, including research philosophy, attitudes and pay scale, in addition to affordability of the degree, must be overcome before scientists with the PhD degree will move into the NARS in numbers large enough to bring about needed improvements.

The University of Nairobi is currently turning out about 30 MSc's and a few PhD's per year, most of whom go into the NARS. Most of these are financed by outside donor fellowships. A large proportion of these MSc's are being trained in the crop sciences. Some are sent overseas for training.

Various groups who have developed training proposals for the NARS have placed much less emphasis on PhD training than will be required if the agricultural research needs of Kenya are to be met in the year 2000 and beyond.

The ISNAR report in 1986 proposed training of only 84 PhDs in the next ten years. The GOK Task Force report of 1986 proposes training 60 in the next five years.

There can be little question that at least half of the research officers in the NARS will have to have PhD degrees if the research system is to solve the complex and difficult problems of increasing agricultural production with limited soil and water resources, great weather variability, increasingly difficult problems of insect, disease and week control and the necessity to protect the people and the environment against unsafe use of chemicals. These problems must be solved before applied research people will have anything to test in on-farm trials.

Action is being take by the MOALD to alleviate the critical lack of MSc and PhD training in the NARS. As of 1986 18% of all research officers were in training for the MSc or PhD. There were 23 MSc holders in training for their PhDs and 60 BSc holders were in training for their Msc degrees. If training were to continue at these levels, about seven or eight PhDs and 30 MScs would be added to the system each year. Many donors are assisting with this program.

This analysis would not be complete without reference to the emphasis on increasing numbers of research officers in the NARS. The Task Force proposes to increase these numbers from 469 at present to 600 by 1991. This 131 person increase will come into the system at the BSc level and will need to be trained to the MSc and PhD levels.

The Task Force Report points out that present research manpower should be adequately trained before adding more people to the system. However, the need for research manpower and the pressures to employ all new BSc's from the University of Nairobi are so great that it is doubtful that this goal can be adhered to. Nevertheless, the goal of insuring that the present number of research officers is adequately trained should be adhered to strictly. If it is not, there will continue to be a bunching of untrained research manpower at the bottom and almost nothing at the top levels in the NARS.

Training Levels in the Private Sector

With reference to the current level of training and experience in the private sector, total personnel in post in 1982 were[1]

Parastatal	
Certificate	200
Diploma	51
BSc	3
Commercial Firms	
Diploma	18
BSc	5
MSc	5
PhD	1

Thus it appears that a very small percentage of total trained manpower is employed in the private sector. Most of it, well over 95 percent, is employed by the MOALD, other Ministries and educational institutions. The survey, concluded in 1982, indicates that private industry needed no additional MSc and PhD trained personnel by 1987. Also, since these private and semi-private industry groups can hire whatever numbers of people they prefer out of the total pool, it is reasonable to assume that there is no shortage of MSc and PhD personnel available to them.

Gravity of the Training Situation

The Task FOrce Report highlights the gravity of the training situation and training needs in the following statements:

1. "In view of the fact that a postgraduate degree, at least to the MSc level with some training in research processes and methodologies, is regarded as prerequisite training for a research officer, it is clear that the majority of research scientists in the system are inadequately qualified. This situation is also aggravated by the fact that most of those scientists are assigned to functions for which their basic training has not in any way oriented them."

---

[1]Source: Professional and Subprofessional Agricultural Manpower in Kenya, 1982, USAID Mission to Kenya, and Government of Kenya, by Earl F. Sealington, Duane A. Olson, and E. Kirk Baker.

2. "... many of the technical officers and technical assistants as designated are in fact not adequately or specifically trained for the functions they perform or are expected to perform."
3. "... skills of serving officers in the areas of organization and management of research , research planning and programming, research methodologies and skill development, monitoring and evaluation procedures and research results communication."

The data in table 4 clearly demonstrates the gravity of the scientific manpower situation in relation to food crop production. It compares the 1986 level of training in the various discipline with the minimum levels required for an effective food crop research system.

Of the 281 research officers assigned to do research in food crop production in 1986, only 5 had PhD degrees — and only 80 had MSc degrees. In other words, only 30 percent had the minimum training required for research as defined in the task force report.

Almost none of the research officers in food crop production have PhD training required to solve the complex problems peculiar to Kenya Agriculture. Most of these problems cannot be solved simply by importing and adopting technology from some other country.

They must be solved by research done in Kenya under Kenya conditions. To solve them require scientists with the highest possible levels of scientific knowledge and research skills.

Seven out of ten research officers were not even trained to the MSc degree level. This level is required to do good applied/adaptive, on-farm-testing types of research. It is necessary for scientifically evaluating new crop varieties under different agroclimatic conditions; testing different methods and rates of applying seed, fertilizer, insecticides, herbicide, etc., and proving the effectiveness of various improved cultural practices.

Size of the PhD/MSc Training Program Needed.

Total magnitude of the training program needed for food crop production in the next ten years is staggering. It requires much more than simply training an additional 150 PhD's and 46 MSc's to make up the difference between the numbers now and the numbers needed. It requires training additional MSc's before they can become PhD's.

It also requires training enough people to offset attrition due to death, retirement and moving to other positions in government, education or private business.

Studies of the attrition rate indicates that it is between four and six percent per year. If we assume a conservative rate of four percent, the number which would need to be trained over the next ten years increases by 48 percent of offset attrition.

A discipline by discipline analysis was made for training, needed for Maize, sorghum and "other food crops" research. The results, shown in Table 5, indicate a need for training a total of 63 PhD's and 114 MSc's during the next ten years for Maize and Sorghum production alone. It will be necessary to train an additional 124 PhD's and 146 MSc's for "other food crop" production. In total, training requirements for food crop production will thus account to 187 PhD's and 260 MSc's.

In summary then, the numbers of PhD's and MSc's which need to be trained for food crop production alone for NARS in the next decade will be:

For	MSc	PhD
Maize	87	56
Sorghum	27	7
"Other Food Crops"	146	124
Total Food Crops	260	187

Table 4. Level of Training, Research Officers, Food Crop Production, 1986

	Total	Current			Minimum Required		
		BSc	MSc	PhD	BSc	MSc	PhD
Breeders							
Maize	16	13	3	0	0	8	8
Sorghum/Mi	5	3	2	0	0	3	2
Pigeon Pea	2	1	1	0	0	1	1
Wheat	5	4	1	0	0	2	3
Cowpea	1	1	0	0	0	2	1
Green Gram	1	0	1	0	0	0	1
Root Crop Breeder	2	2	0	0	0	1	1
Potato	1	1	0	0	0	0	1
Legume	1	1	0	0	0	0	1
Bean	1	0	1	0	0	0	1
Vegetable	1	0	0	1	0	0	1
Small Cereals	2	2	0	0	0	1	1
Oil Seeds	4	3	1	0	0	2	2
Cashew	1	1	0	0	0	0	1
Casava	1	1	0	0	0	0	1
Fruit	1	0	1	0	0	0	1
Agronomists	48	37	10	1	0	24	24
Pathologists	29	15	13	1	0	14	15
Entomologists	40	31	9	0	0	20	20
Ag Economists	12	7	5	0	0	6	6
Plant Physiolo.	1	0	1	0	0	0	1
Seed Specialists	3	3	0	0	0	3	0
Weed Scientists	1	0	1	0	0	0	1
Soil Fertility	4	4	0	0	0	2	2
Soil Chemists	23	16	7	0	0	12	11
Soil Physicists	6	4	2	0	0	3	3
Soil Scientists	21	14	7	0	0	10	11
Agr Chemists	5	4	1	0	0	2	3
Bio Chemists	4	2	2	0	0	0	4
Biometrician	9	6	3	0	0	4	5
Cereal Chemist	2	2	0	0	0	1	1
Virologist	4	2	2	0	0	0	4
Horticulturists	2	2	0	0	0	1	1
Food Technologists	2	1	1	0	0	1	1
Agr Meterologists	5	3	1	1	9	2	3
Microbiologists	1	0	1	0	0	0	1
Bio Control	4	2	1	1	0	2	2
Geneticists	5	3	2	0	0	0	5
Tillage	1	0	0	0	0	0	1
Agr Engineer	7	6	1	0	0	3	4
Total	281	196	80	5	0	126	155

1) Summarized from date in Annex of MOA:D Task force report on Research.

Table 5 Total Training Requirements for Maize, Sorghum and "Other Food Crops", 1987-96

Discipline	MSc				PhD			
	Maize	Sorg	Other[1]	Total	Maize	Sorg	Other[1]	Total
Breeders	8	3	19	30	8	2	19	29
Agronomists	10	2	18	30	6	1	13	20
Pathologists	2	2	3	7	2		1	3
Virologists	1		1	2	1		2	3
Entomologists	4	3	2	9	2	1	2	5
Biochemists	2			2	2			2
Weed Scientists	2			2	1			1
Soil Scientists	4	1	2	7		1	4	5
Ag Economists	6	1	4	11			2	2
Ag Chemists	2	1	2	5			1	1
Soil Chemists	4	4	1	9			6	6
Home Econo. Nutri.		1	1	1				
Hydrologist	1			1	1			1
Soil Mineral.	2			2	2			2
Soil Physicist	1		1	2	1		1	2
Disease i.d. (Path.)		1			1			
Bio Control Entomolo.		1		3	4	1	3	4
Armyworm Entomologist						1		1
Pest Biologist	1			1	1		1	2
Pesticide Use					1		2	3
Post Harvest Pests					1		2	3
Storage Engineer	1			1				
Stor. Prod. Microbio.		1			1	1		1
Pesticide Analyst	1		2	3	1		3	4
Agrometeorologists	1			1	1			1
Geneticists					1		1	2
Plant Physiologists			1	1	1		1	2
Agr. Engineers			1	1				
Soil Surveyors	2		1	3	2			2
Soil Micromorpholo.							1	1
Climatologist	1			1				
Bacteriologist					1		2	3
Analytical Chemist			5	5				
Seed Specialist			3	3				
Soil Microbiologist			1	1			2	2
Biometrician			7	7			2	2
Nematologist			2	2			2	2
Horticulturist			6	6			2	2
Food Scientist			2	2				
Post Harvest Technolo.				1	1			
Cereal Chemist			1	1				
Taxonomist			1	1			1	1
Agr. Eng., Design			1	1				
Agr. Eng., Anim. Trac.							1	1
Soil Mineralogy							1	1
Fungicide Evaluation				1	1			
Entomologist:								
Pest Survey			3	3				
Pesticide Use								
Irrigation Engineer			2	2				
Drainage Engineer			2	2				
Tot. not inc. attri.	59	18	99	176	38	5	84	127
Tot. inc. 4% attri/yr.	91	28	149	268	59	8	129	196

1) Other Food Crops

Training in Disciplines Needed for Food Crop Production Research

The areas of research concentration given in Table 4 provides detail on the various disciplines in which training for maize and other food crop production research should be concentrated. They include:

Plant Breeding, not only for maize but for all other food crop species. In all of Kenya in 1986 there were only 46 plant breeders to cover all the food crops except rice. One out of three of them were devoted to maize. None of these researchers had PhD degree training required for the knowledge and skills necessary for developing new varieties resistant to all forms of insects and diseases, even bird predation. Only 10 had MSc degrees, the training required for testing various new lines and varieties under various soil, moisture, insect, disease, and other farming conditions in at least 23 agroclimatic zones.

Thirty-six were BSc's, largely untrained for their work. Thus the BSc's were only a very minor force in meeting the Nation's need for developing new varieties for each of the various species. Perhaps the lack of adequate training helps explain why the development and release of new varieties of crops has languished in Kenya in recent years.

All this takes on more importance, too, when the fact is considered that resistant varieties must be developed to counter new biotypes of insects or diseases which develop on their own about every five years. This applies to all the plant species. Dr. John Schmidt, a renowned wheat breeder in Nebraska spent his life staying ahead of new strains of the wheat stem rust virus alone. He released 21 new varieties, 19 of which had resistance to a new strain.

The importance of highly trained plant breeders to Kenyan agriculture cannot be overstressed. In fact, perhaps when the large number of crops, the large number of agroclimatic zones and the large number of research stations are taken into account, this may be one area of research in which the desire of the MOALD to increase numbers of scientists is much too conservative, rather than being overdrawn as it may seem on first examination.

Agronomy, or crop production as it is referred to in the United States. This includes all aspects of cultural practices such as seeding rates, row spacing, rates of fertilizer application, fertilizer placement, depth of seeding, intercropping, cropping systems, etc. There were only 48 agronomists assigned to research in all food crop production research in 1986. And of

these only one had a PhD, with 26 MSc's. They, too, are required to cover all food crops in Kenya, with all of its varying soil, rainfall, altitudes, and other variables which must be researched to improve crop production in Kenya.

Plant Pathology. There were 29 research officers assigned to plant pathology problems in 1986, one PhD, 13 MSc's and 15 BSc's. Of the four virologists, a highly technical area of research, only two were MSc's and none were PhDs. Plant pathology departments in the United States do not have BSc degrees. They only train MSc's and PhDs in this discipline after they have had a BSc in agronomy. In this discipline the PhD is considered the minimum scientific training for research. A high percentage have post doctoral training before they are placed in an on-going research program. Imagine a BSc tackling a complicated blight or fungus disease problem armed with only one or two undergraduate degree courses!

This same story goes on and on in all the disciplines required for food crop production.

Every single discipline listed in Table 4 needs people trained to the PhD level.

MSc and PhD degree training in all these disciplines is available in College of Agriculture departments in the United States as follows:

Department	Discipline
Agricultural Economics	Farm Management, Marketing, Etc.
Agricultural Engineering	Hydrology, Irrigation and Drainage
Agronomy; some Departments are divided into: 1) Soils, and 2) Crops	Plant Breeding; Agronomy (Crop Protection) Plant Physiology; Soil Chemistry Soil Microbiology; Soil Fertility; Soil Physics; Weed Science; Plant Nutrition
Entomology	Entomology
Plant Pathology	Pathology, Nematology, Virology
Horticulture	Fruit and Vegetable Breeding & Production
Physics (or Agronomy)	Agroclimatology
Agricultural Chemistry	Biochemistry
Nutrition (Home Economics)	Foods and Nutrition

Agronomy is the department which includes more high level training in the specialized disciplines required for crop production than any other. MSc and PhD training in these departments allows trainees to both a) develop a broad base of scientific knowledge in the various disciplines on which crop production is based, and b) to acquire a specialty such as plant breeding, soil physiology, etc.

Various departments of agronomy have strengths in different areas. It is important that this be taken into account in deputing students for training in the United States, too.

Projected Training Rates, Total NARS, 1987-96

In the following discussion please remember that this applies to the total Kenya NARS—with the exception of Tea, Coffee, and Veterinary Science, which were not included by the Task Force.

As of 1986, 23 of the 192 MSc holders in the Kenya NARS were undergoing programs for the PhD degree. Sixty of the BSc degree holders were working on their MSc degrees. Assuming that one third of the PhD students and one half of the MSc's will finish each year, the number of Phds should increase by about eight per year, and the number of MSc's by about 30.

If this current rate is sustained, it is estimated that there would be 83 PhDs and 322 MSc's in the NARS by the year 1996. (See Table 6 and Annex 4)

Table 6. Estimated Total PhD and MSc Manpower, NARS, Under Alternative Training Plans, End of Year, By Year, to 1996.

	1986 Rate of Training[1/]			Task Force Rate[2/]			State 40 MSc's & 20 PhDs Per Year		
	PhD	MSc	Total	PhD	MSc	Total	PhD	MSc	Total
1986	23	206	229	23	206	229	23	206	229
1987	30	220	260	30	213	243	31	217	248
1988	37	233	270	37	265	302	49	228	277
1989	44	246	290	44	315	359	64	239	303
1990	50	258	308	57	363	420	79	249	328
1991	56	270	326	70	416	486	83	258	341
1992	62	281	343	82	423	505	97	267	364
1993	68	292	360	94	430	524	110	276	386
1994	73	302	375	98	437	535	123	284	407
1995	78	312	390	102	443	547	135	292	427
1996	83	322	405	106	449	555	146	299	445

1/ Starting 30 MSc's and 8 PhD's per year.

2/ a) Training 300 MSc's first five years (60 per year), then reverting to 30 per year (1986 rate).
b) Training 60 PhD's first five years (12 per year), then reverting to 8 per year (1986 rate).

At least part of the reason for this rate of output of MSc's is that the University of Nairobi is now turning out about 30 MSc's in Agriculture and Veterinary Medicine each year. This compares with two per year in 1975. University of Nairobi personnel have said that this number could be increased if there were recurrent cost money to support the research program. This would increase the capacity to utilize the excellent staff capability which is already there. In addition to the University of Nairobi program, there are other Msc's being trained in overseas programs supported by various donors.

The Task Force training program proposes the training of 300 BSc's to the MSc level in five years (Table 5). This is a rate of 60 per year. This means that almost 120 BSc research officers would be away from their posts each year for several years. There are quite obviously enough BSc's available from which to draw these numbers. However, this would cause an absence of one fourth of the current total force of 469 research officers from their posts.

The Task Force also proposes the training of 12 MSc's to the PhD level each year during the next five years. This would take a total of 36 away at any one time, but this is only one in six of the MSc's.

If the numbers trained for the PhD and the MSc levels dropped back to the 1986 rate of training after five years, there would be 100 PhDs and 449 MSc's in the NARS by the end of 1996. This would be a ratio of only one PhD to four MSc's.

An alternative proposal to the Task Force Report is to start 40 BSc's and 20 MSc's per year toward their MSc and PhD degrees. This would result in a ratio of one PHD to two MSc's instead of one to four by 1996. It would be moving more nearly in the direction needed for a strong agricultural research program, but would still not solve the problem.

This rate of training for MSc's is only 10 per year higher than now (40 vs 30). It is only 12 higher (20 vs 8) for PhD training.

The major point here, though, is that even if the number of MSc's being sent for their PhDs is stepped up from eight per year to 20, it will still not train as many PhDs as are needed to build a base of scientific knowledge adequate for Kenyan agriculture.

Categories of Training Needed-General

The following statement of training needs for NARS is developed from the above tables and from needs described in the MOALD/ISNAR Reports of 1982 and 1985:

A. Serving Officers -- Short Term Training

1. Administrators. To provide administrators the knowledge and skills necessary for a) organization of a successful research station or unit; b) allocation of resources to achieve maximum output of research for each unit of resources; c) personnel management, evaluation, involvement, development and motivation; d) budgeting; 3) accounting; f) research program development; and g) quality control.
2. Accountants. To provide accountants the knowledge and skills necessary for modernizing budgeting and accounting procedures and providing administrators information needed for effective decision making.

B. Research Scientists

1. PhD. To provide the greatest possible breadth and depth of knowledge in a scientific discipline, and the self discipline and ability to conceptualize problems, develop objectives, design procedures, implement experiments, make skilled observations, draw rigorous conclusions, and write up the results. This training is necessary for research on difficult problems and for the people who are to provide leadership for and administration of research programs. This training requires about three years beyond the MSc for most students.
2. MSc. To provide minimum qualifications for research scientists in a research discipline, including basic knowledge of a discipline, research methodology and the ability to design and conduct scientific research in the laboratory, at research stations and on farms. This requires about two years beyond the BSc.
3. BSc, Supplement Training - To develop research skills which enable them to conduct applied research and on-farm trials. Most BSc's have had little or no training in research methodology and statistics, the basic tools of the research scientists. There are several hundred in this category who have been appointed to research officer positions.

C. Research Support Staff

1. Technical Officers and Technicians--Short Term Training. The technical officers and technologists (diploma level), are well trained in production skills. However, they are not trained in the skills of implementing on-farm research trials, layout of plots, application of various practices and treatment, observation and recording of results, and simple analysis of comparative data. This needs to be done in specialized training. This training can be done along with BSc's who are to receive "supplemental training."

2. Technical Assistant Training--Short Term (one week to two months). Technical assistants and technicians (certificate level) usually have two years of practical training in agriculture or technical skills training at a training institute. To carry out their functions they need narrowly based training for performing various specific functions in a laboratory, in experimental plots or on farmers' fields, in maintenance and repair of equipment, etc.

Recommended Location of Training for MSc. PhD and Methodology, Analysis of Alternative Source

Alternative Sources include US Land Grant Universities, University of Nairobi, other universities and International Agricultural Research Centers.

1. US Land Grant Universities:

— Curriculum. Courses are available in all the relevant basic sciences as well as agricultural subjects. The curriculum includes formal course work in research methodology, experimental design, statistics and mathematics. Special high level courses are taught for MSc and PhD students.

— Faculty. Practically all faculty members have PhD degrees. Most of them conduct quality research programs in their disciplines, some quite large. They are oriented to meeting the needs of students and of the farmers of the State. They are close to both. Almost all have farm background.

— Research Program. Agricultural experiment stations in each State conduct comprehensive, mission oriented research programs for the benefit of farmers and the people of the State. The number of research scientists is two to four times as large as the teaching faculty. Many have joint teaching and research appointments. Research covers the complete spectrum from basic research to the most applied/adaptive research in various locations and on farms throughout the State.

— The System of Graduate Education. Students are required to take and pass a minimum number of subjects related to their discipline. At the end of their formal coursework, they are required to pass written and/or preliminary examinations before they do their thesis research. At the conclusion of their research, they sit for an examination on their thesis project.

— Costs of Training. Total costs of transportation, room/board, tuition, books, and supplies for training in the US come to about $20,000 per year. This makes the cost of a PhD degree about $60,000 (for three years) and an MSc degree about $40,000 (for two years).

2. University of Nairobi:

— Curriculum. Courses are available in the basic sciences and in research methodology, mathematics, and statistics. However, with limited faculty members it is not possible to teach a range of courses in agriculture as complete as in the larger agricultural universities in the United States and other countries. There are practically no PhD level courses.

— Faculty. Most of the faculty members in agriculture have PhDs, the majority of these from the United States. Some of them have both teaching and research responsibilities. It is fully anticipated that the research program at the University of Nairobi will be expanded enough to provide thesis research opportunity for many more students.

— Research programs. Research programs are small due to shortage of funding for recurrent costs. The faculties have the capacity but the small research program, due to a shortage of recurrent funds, limits their capacity to provide thesis research projects for students in the post graduate degree program. Many must return to their research stations to do their thesis research.

— The system of graduate education. Students are not required to take a schedule of formalized coursework as part of their PhD education. After they finish their thesis project, they sit for an examination on their work and findings. For the MSc, however, there is a "taught" program prior to the conduct of thesis research for the degree.

— Cost of training. The cost of post graduate training at the University of Nairobi for a student from Kenya is less than half as much as in the United States. Depending upon how costs are calculated, it is a maximum of about $8,000 per year.

3. Other Countries;

— Curriculum. MSc and PhD degrees are offered at many universities in the industrialized countries. They have coursework available in all the basic sciences as well as in agriculture. They have upper level courses for MSc and PhD students. They teach research methodology and experimental design as well as statistics and mathematics.

— Faculty. Faculty have PhD and are well trained as any in the world. Many conduct research programs in their laboratories as well as on research stations.

— Research program. Research programs may not be quite as closely oriented to the farmer and his problems as in the United States, but they are highly sophisticated and rigorous.

— The system of graduate education. Systems vary from university to university. Most are more nearly represented by the British system, as in Kenya, than by the United States system. Many produce outstanding scientists and have excellent reputations.

— Costs. No details are available, however, it is estimated that most would cost less than the United States, but more than Kenya.

4. International Research Centers:

— Curriculum. Information is not available to make a thorough analysis of the available curriculum.

— Faculty. Faculties are as well trained as any in the world. They have been selected for work at the International Center because of their excellent training and ability to conduct first class research programs.

— Research programs. Research programs are large and sophisticated. They are, however, oriented to the specific mission of the center; e.g., Maize and Wheat at CIMMYT.

— Costs. Specific data are not available on costs of training at an IARC. However, it is reasonable to assume that they are significantly less costly than for US trainees and significantly more costly than that at the University of Nairobi. Availability of training slots at the IARCs are often limited in number.

Recommended Location of Training

PhD Students:

It is recommended that students who are to be funded for their PhD Degrees by USAID be sent to the United States. Even though the cost is high, the system of formal course work provided to the student is extremely valuable. It provides the maximum possible depth of knowledge in the subject matter related to the subject of the student's PhD. Numerous Kenyans indicated they believed they taught PhD program to be superior to that of the "Thesis only" program.

MSc Students

It is recommended that most students pursuing their MSc degree be sent to the University of Nairobi. The faculty in the College of Agriculture and Veterinary Medicine at the University of Nairobi now are well trained and very capable of providing excellent teaching and thesis research supervision for the students.

In disciplines for which the research program at the University of Nairobi is not as well developed as might be desirable, the student can return to his post to do his thesis research. For this, a second supervisor at a research station or Egerton College or Moi University or Jomo Kenyatta College of Agriculture can be appointed to assist the student with his research.

The lower cost of MSc training at the University of Nairobi compared with the United States permits training many more students for a given amount of money. This will help raise the level of training and strengthen the agricultural research system in Kenya.

In addition, it will help provide the University of Nairobi the necessary support and incentive to move ahead in the development of its graduate training programs.

The International Agriculture Research Centers have specialized, well developed programs for training a limited number of MSc students. It is recommended that a number of MSc degree fellowships be issued to send MSc students to CIMMYT to do their thesis research after they have completed their course work at the University of Nairobi. The cost would be somewhat higher to send students to CIMMYT, but the program there is excellent and would add a valuable dimension to the maize research scientists' training. The number of trainees is limited.

Short Term Training in Research Methodology

The Task Force Report calls for large numbers of new research officers with BSc degrees and technical officers with diplomas at the IARCs in research methodology.

Such training at the IARCs is high quality and well done. However, it is quite costly. Also it has been pointed out that it is highly specialized and some Kenyans who have received it have not found it altogether useful. Also, some difficulty has been experienced in getting junior research scientists and technical officers to take this training. They fear that if they do so, they may lose an opportunity to go overseas for MSc and PhD training.

This training can be developed and done perfectly well at the Agricultural Resource Center at Egerton College. Egerton College and the University of Nairobi have trained scientists who can teach students all the necessary knowledge and skills for this important function. Egerton has the necessary land to use for the training. It has facilities for housing students and conducting the training.

Training conducting the methodology training at Egerton College would have several advantages:

1. The training could be more realistically oriented to the specific needs of Kenya research scientists, hence to Kenya myself.
2. Estimates indicate that about three students can be trained in Kenya for the cost of one sent overseas to an IARC.
3. If conducted at the Agricultural Resource Center at Egerton College it would be using this national resource for the purpose it was originally intended to serve.

THE NEEDED TEN YEAR PROGRAM

The following pages outline the components and needed levels of training for an overal ten year training program for the Kenya National Agricultural Research Service. Most of the analysis to this point has centered around the need for MSc, PhD training and training in management and methodology. This is necessary for development of the minimum scientific manpower base for agricultural research. However, there are additional components needed for a balanced program which provides on-going training for other people in the system as well as the MSc, PhD and methodology training necessary to improve the basic level knowledge and skills of Research officers. Management training for administracors is one example of such on-going training.

It is emphasized that these elements can be combined at any level desired by those who make the final decision concerning the total program - its level, and the relative emphasis on various elements. The budget data developed for each element is included in Annex 5. This budget data can easily be used to calculate the costs of each element of the program at any level. The combination of elements and the level of each in the program depends on many variables including the values and judgments of USAID and MOALD officials who will finally determine the size and scope of the program.

Elements of the ten year training program for Agricultural Research Scientists in Kenya outlined here have been discussed with officials of the Ministry of Agriculture and Livestock Development, the National Range Research Station at Kiboko, faculty members from Texas A&M University, representatives of Winrock International, long term US consultants and former participants in various programs. Dr. James Matata, Director of Training in the NARS was especially knowledgeable and helpful in his suggestions. He has had rich and valuable experience. His analysis, insights and judgement were extremely helpful.

An Overall Program—Components

Summary

1. Research Administrators (Management Seminar)
   - Training Seminars to US Agr. Experiment Stations
   - Four Groups of 10 to US two sessions per group
   - 6 weeks per group
   - Total participants — 40

2. PhD Student Training in the US
   - 100 Student Trainees

3. Major Professor Trips to Kenya
   - Two on-month visits, one at beginning of thesis
   - Research and one after completion

4. MSc Fellowships to CIMMYT
   - 54 Students trained

5. MSc Fellowships to CIMMYT
   - 4 per year to do thesis research
   - Total — 40

6. Accountant training
   - Training Seminars to US Agr. Experiment Stations
   - One group per year, 10 participants
   - Three years
   - 30 total participants

7. Research Methodology Training (at Egerton)
   - 8 weeks per group
   - 2 groups per year first 5 years, then one per year
   - Total number trained — 450 (15 groups of 30)

8. Research Analysis and Write-Up (at Egerton)
   - Five weeks per group, 20 per group
   - Two groups per year
   - Total trained — 400

9. Advanced Research Scientist Seminars
   - Taught by Senior Scientists from USA
   - One course per year, 4 weeks, 20 participants
   - 10 courses

10. Visited Scientists to US
   - Each Scientists to work 6 months with a US Scientists in his laboratory
   - Total — 60 (6 per year)

11. Visiting Professors to University of Nairobi
   - Two per year, two terms each
   - Total — 20

12. On-the-Job training for equipment repair technicians.
   - Specialized trainer rotating to all stations.

13. Administration — Project Leader in Kenya and Support Staff in US.

PhD Training at U.S. Agricultural Universities

The program will train 100 PhD degree students at U.S. Land Grant Universities during the period of the contract. It will start 10 research scientists into the program the first year and 15 per year for the next 6 years, finishing the last one in the ninth year of the project.

Students should be sent for training to those U.S. universities where programs are excellent in agronomy, genetics and plant breeding, plant pathology, agricultural engineering, entomology and agricultural economics. Since the major emphasis is on maize production, most of the students should be sent to universities in the corn belt. Those who are to receive training in sorghum breeding and production should be sent to one of the States where

sorghum is an important crop and where there is an excellent agronomy program.

One way to maximize the probability that the trainees will work on maize production on their return to Kenya is to train them in agronomy departments where major emphasis is on maize productions.

There are somewhat limited numbers of MSc degree holders to become qualified PhD trainees in the NARS at the present time. However, there are about 30 new MSc's returning to the system each year. and many of them should qualify for PhD training. For example, several of the newly trained MSc's at the Kiboko range research station, all trained in the U.S. would be good candidates for PhD training in agronomy at one of the Land Grant Universities in the United States.

The program for each PhD student should be organized with the following elements:

1. Course work to be taken and preliminary examination passed at the University.

2. The student will select a problem of Kenyan agriculture for his thesis project and return to Kenya to conduct his research and gather data. When this is done he will return to the United States to analyze his data, write his thesis and take his final examination.

3. The student's major professor will go to Kenya for approximately one month to assist the student in design of his project and establishment of procedures for conducting his research. This will be done before the student begins gathering data.

4. After the student finishes his PhD and returns to his position in Kenya, the major professor will go to Kenya for a follow-up visit of one month. During this visit he will consult with the student concerning his research program and procedures, review and make recommendations on the overall research program in which the student is involved and conduct lectures or seminars on his field of research.

This procedure is being practiced by numerous land grant universities in training foreign graduate students. It is highly recommended by Kenyans and

others for several very good reasons:

1. The thesis research project conducted by the student will provide information useful for the improvement of agriculture in Kenya.

2. By doing his thesis research in Kenya the student will require no re-orientation to Kenyan agriculture from that in the U.S. when he returns to his post in the NARS.

3. Once the student has become involved in research on the problems of Kenyan agriculture, he will probably have less tendency to leave the NARS.

4. If married, the student will not be away from his/her family for the whole time of securing his PhD.

MSc degree training at the University of Nairobi

The program will consist of two parts:

1) Fellowships for MSc degree students at the University of Nairobi.
2) In addition to the tuition fellowship, a $5000 grant would be provided to the MSc student for support of his research. This fund could be set up for the student and his supervisor to draw upon to pay expenses associated with the student's research project. It would be quite simple to set up a procedure to account for and monitor the expenditures of these funds.

This would give the student excellent experience in budgeting his research expenditures within finite resources. It is a common procedure used in research to spend and account for funds.

This fund would effectively supplement the recurrent cost funds for agriculture research available to the student's major professor. It would help expand the agriculture research program of the University of Nairobi.

Specific items for which the MSc research could be used would include:

- Economic surveys
- Land preparation
- Casual labor

- Fertilizer and pesticide
- Small equipment and spares
- Vehicle operation and maintenance
- Office supplies
- Travel in Kenya
- Salaries and allowances for research support staff
- Data processing and analysis
- Publication of research findings

Fellowship for MSc Thesis Research at CIMMYT

CIMMYT has excellent scientists and an outstanding maize research program. It would provide a superior opportunity for students to do their thesis research. Although space is limited there, it would be a good supplement to the MSc training program to send 3 or 4 students there per year.

Hands-on Research Methodology Training. This training would be conducted at Egerton College for research officers and technical officers. This training should be completed in 8 weeks. It will cover all aspects of laying out research test plots, preparing the soil, planting the crop to research specifications, tending the crop, making and recording observation as the crop progresses, harvesting the crop, analyzing the results, and writing a report on the research findings.

This program should be conducted for two groups of 40 people each per year. Thus, it would train 80 RO's and TO's each year.

This training is urgently needed to improve the productivity of the many people who did not receive it in their BSc or Diploma Training Programs.

Research Management Traveling Seminars - for Research Station heads and department heads in the NARS. These seminars would involve 6 weeks of studying the organization, management and operation of several State agricultural experiment stations and branch stations in the United States including a one-week workshop or seminar on principles and practices followed by successful station managers.

Each participant would attend two seminars, one year apart. The first seminar would be designed to introduce him to the fundamentals of station management and operation and to generate enthusiasm and ideas to implement at

his own station. The second would provide him an opportunity to re-examine and clarify in greater depth the ideas he implemented during the year following his first seminar.

These seminars would be designed for four groups of 10 participants each. They should provide for an experienced U.S. agricultural experiment station head to organize the seminars and be a traveling consultant with the group.

Visiting Scientists to U.S. - to provide opportunities for senior scientists who have been at their post for several years a "sabbatic leave" type opportunity for self renewal and revitalization in their field of agricultural research. The most effective way for this to take place is to provide them opportunity to work directly with a recognized outstanding scientist in his laboratory in the United States.

This system is practiced by the Republic of China. It has over 11,000 scientists working with U.S. Scientists in their laboratories at the present time. The visiting scientist actually contribute valuable work and stimulation to the U.S. scientist as they work and learn together.

It seems obvious that the place to do this best is in the United States.

Advanced Research Science Seminar

As new specialized areas of scientific knowledge and research methodology associated with them develop, agricultural research officers in Kenya need the opportunity to learn about them from outstanding scientists who are in the forefront of the developments.

There are two alternative ways this can be done. They are:

a) take a group of scientists from Kenya interested in these developments to the United States for training or

b) bring a leader scientist to Kenya from the United States to teach the group this important information for a month.

It is far more economical to "bring the teacher to the students" in this case than to "take the students to the teacher."

Therefore it is recommended that leading scientists from the United States (or elsewhere) be brought to Kenya for this training.

Research Station Accounting - For research station and other accountants.

Each research station has an accountant who is the right arm of the station head in preparation of budgets, accounting for all expenditures of

funds and providing the station head with information useful in management of the station.

Each agricultural experiment station in the United States has an accountant who performs similar functions.

This program would take accountants from the Kenya Research Stations and Headquarters to the United States to learn from Agricultural Experiment Station accountants. They would discuss: a) the budgeting system b) how funds are allocated to departments, scientists and to research projects c) accounting methods and procedures and d) formats for information provided to the station director for use in decision making.

As with the research management seminars, these seminars would provide motivation and stimulation as well as information and skills for improving the budgeting, accounting, and management system.

It is recommended that three groups of ten accountants each be sent to the U.S. for the training, total 30 participants.

Visiting Professor to the University of Nairobi

Provide the equivalent of two visiting professors from the United States each year to teach courses which are needed to supplement the training of the University of Nairobi faculty is able to offer. These should be high caliber faculty with special knowledge and skill.

The reason for the one year visiting professorship as opposed to a 2 year or more "substitute teacher" is that some of the best teachers in U.S. Agricultural Universities can be attracted for a 1 year assignment, but would not be willing to leave their regular position for 2 or more years. Senior faculty housing should be provided by the University of Nairobi for these visiting faculty members.

Maintenance of Equipment Training

Much equipment at various research stations is idle a great deal of the time because personnel at the station do not have the knowhow and skills to repair it. If the equipment is inoperable, the work of the station doesn't get done.

It is therefore proposed that a person highly skilled in maintenance of various kinds of equipment be brought to Kenya to assist in this maintenance and provide on the job training for key personnel at the research stations.

He would be stationed in Nairobi and would travel to the various stations to assist with the repair of equipment and provide on-the-job training for at least two people per station.

The person would be called an equipment maintenance engineer and would remain in Kenya for 2 years.

SIZE AND COST OF THE PROGRAM

Each of the above components is needed in any training program to improve the level of knowledge and skill of research officers and other personnel in the Kenya National Agricultural research system. Decisions as to the precise level of each component to be supported by USAID will be determined by numerous variables, some of which are:

1) Total dollar available for the project.
2) Relative importance (percent) of training to other parts of the total program.
3) Relative importance of each component of the training program to the success of Kenya NARS.
4) Relative importance of each component to the production of maize and sorghum.
5) Components which other donors are willing to support.
6) Which components the Government of Kenya is willing and able to support with its own resources.

The authors of this proposal developed detailed cost analysis data for each component of the program. See annex 5. It is based primarily on USAID program budgeting suggestions contained in Participant Training notice 85-6, 4/10/85 and training costs in Kenya as indicated in the task force report. It was necessary to use personnaly estimated costs for a few elements in some of the components. The 1986 base costs were compounded at a 5% inflation rate from 1986 through 1996.

A large factor in the cost of the program is the cost of administration. As these costs are presented here, the administration of the training program would stand alone. If the administration of the training component can be combined in some way with the administration of other parts of the research project, it may be possible to reduce them somewhat.

In preparing the budget, an efficient size of unit for training was first determined for each component e.g. 20 students for a class in research analysis and write-up, one PhD student, etc. Next, the various costs of teaching our unit were analyzed and totaled for each component e.g. costs of a visiting scientist to conduct the advanced science seminars plus direct costs for participants. These total costs per unit of training were then divided by trainees per unit to get costs per trainee.

Finally, using the costs per trainee for each year times the number of trainees in the program, the cost per year of each program component was determined.

Based on this data, total program costs were determined for several alternative combinations of components and levels of training within each component.

The data in table 7 provide average costs for the 10 year period for each trainee. For components in which participants are trained in groups, the group size and costs per group are indicated. These group sizes are costs were maintained in developing component for various levels of program.

Table 7. Estimated Average Total Cost Per Participant and Per Group, 1987-96

Component	Group Size	Cost per Group	Cost per Participant
Research Adm Seminar	10	$ 114,850	$ 11,485
Accountant Seminar (US)	10	114,850	11,485
PhD	1	-	77,017
Major Prof. Trip	1	-	7,317
MSc fellowship (UNBI)[1]			28,127
MSc Thesis fellowship (CYMMIT)[2]			14,734
Adv. Science Seminars	20	36,031	1,802
Visiting Scientist to US	1	-	15,403
Res. Methods Training	30	62,940	2,098
Res. Anal. & Write-up	20	38,500	1,925
Visiting Prof to UNBI	1	-	68,210
Equipment Maintenance	1	-	3,135[3]

1 Includes Thesis research grant
2 1 year only
3 Assumes one trainer averages 150,500 per year who trains 48 technicians per year on the job.

Alternative Levels and Mixes of Program Components.

Several alternative levels of program and several mixes of program components, with the rationals for each are presented in the following pages. These alternatives were analyzed to facilitate the work of decision makers who

will decide the final levels and mix.

The alternatives include:

Alternative 1 - The Complete program at levels outlined in the base program. Cost of this level turned out to be 22 million for the ten year program. This is more than was budgeted for this component of the total research program. The program and year by year costs are shown in tables 8 and 9.

Alternative 2 - A program with the total cost scaled down to 15 million.

Components of this program would be:

		COST
1.	Train 60 PhD's	$ 4,462,000.
2.	One major professor trip per PhD	492,000.
3.	Train 36 MSc's at the University of Nairobi	1,003,000.
4.	Thesis research grants to CYMMIT for 20 MSc Trainees	289,000.
5.	Train 9 groups of 30 (270) in research methods at Egerton	630,000.
6.	Train 12 groups of 20 (240) in research analysis and write-up at Egerton	417,000.
7.	Conduct advanced research seminars in Kenya for 6 groups of 20 scientists	211,000.
8.	Send 60 scientists as visiting scholars with US Scientists	910,000,
9.	Conduct two years of on-the-job training for equipment maintenance technicians	301,000.
10.	Conduct research management seminars in the US for two groups of research administrators (10 each)	414,000.
11.	Conduct US seminars for two groups of research accountants	197.000.
12.	Provide no visiting professors to the University of Nairobi	0.
13.	Administration	5,284,000.
	TOTAL COST	$ 14,610.000.

Details of the program and year by year costs are shown in tables 10 and 11.

Alternative 3 - A program designed to meet the needs of training specifically for the maize and sorghum program. The cost of this program went up from $15 million to nearly $17 million due to an increase in the number of MSc fellowships at the University of Nairobi from 36 at the $15 million level to 115 needed for the maize and sorghum program.

Several points should be noted concerning this increase. First, this is a

realistic number of MSc's which will need to be trained based on: a) needs of the maize and sorghum program b) inclusion of training for both present and additional needed personnel and c) numbers needed to compensate for attrition. However, the authors believe that the present momentum of support for MSc training for GOK and other donors will provide for much of this need during the next 10 years.

Therefore, if a reduction needs to be made due to budget restrictions, the numbers of MSc trainees could be reduced to 35 or 40, the level of the $15 million program in alternative 2.

Components of this program would be:

		Cost
1.	Train 60 PhD's	$ 4,462,000.
2.	One major professor visit per PhD	492,000.
3.	Train 115 MSc's at UNBI	3,292,000.
4.	Thesis Research grants to CYMMIT (20 trainees)	289,000.
5.	Train 9 groups of 30 (270 total) in research methods at Egerton.	630,000.
6.	Train 12 groups of 20 (240 total) in research analysis and write-up at Egerton.	417,000.
7.	Conduct advanced research seminars in Kenya for 6 groups of 20 scientists.	211,000.
8.	Send 60 scientists as visiting scholars to work with US scientists	901,000.
9.	Conduct 2 years of on-the-job training for equipment maintenance technicians	301,000.
10.	Research Management seminar in the US for 2 groups of research administrators (10 each)	414,000.
11.	US Seminars for two groups of research accountants	197.000.
12.	Administration	5,284,000.
	TOTAL	$ 16,890,000.

Tables 12 and 13 detail the components and costs of the program for Alternative 3.

Alternative 3 - A program scaled down to $17 million but keeping the training of 100 PhD's intact. This program was arrived at by eliminating some components of the training program altogether.

Components of this program would be:

		Cost
1.	Train 100 PhD's	$ 7,432,000.
2.	Two major professor visits per PhD	1,595,000.
3.	Conduct advanced science research seminars in Kenya for 10 groups of 20 each	355,000.
4.	Send 60 scientists as visiting scholars to work with US scientists	911,000.
5.	Conduct 2 years of on-the-job training for equipment maintenance technician	301,000.
6.	Research management seminars in the US for 4 groups of research administrators (2 visits each)	918,000.
7.	U.S. Seminars for two groups of research accountants	313,000.
8.	Administration	5,704,000.
	TOTAL	$ 16,841,000.

The reduction of program components from the 22 million level and a rational for each is as follows, with reductions listed in priority order:

1. Cut out the Visiting Professors to the University of Nairobi. The faculty there is presently underemployed and this simply cuts out supplemental areas of training to improve quality.

   Savings: $ 1,364,000.

2. Cut out the training of MSc candidates at the University of Nairobi. There are other donors who will likely provide these fellowships if the US does not. Also the recurring cost funding will increase the capacity of the University to accept more students.

   Savings: 1,139,000.

3. Cut out one of the four groups of Station Heads/Administrators sent to the US for Management Seminars.

Savings: 233,000.

4. Cost out the Short Term Training in Research Analysis and Write-up. The same analysis applies to the Methodology Training.

Savings: 770,000.

5. Cut out the training of 40 MSc thesis trainees to CIMMYT. There is some question that CIMMYT might be able to accept this many additional students from Kenya.

Savings: 581,000.

6. Cut out the short term training in Research Methods. If the GOK is serious about this training, it can do it Egerton for less that the cost to US as a donor.

Savings: 906,000.

Total Savings: 4,993,000.

Tables 14 and 15 detail the components and costs of alternative 4.

Alternative 5 - A program scaled down to the $12 million level, training only 70 PhD's.

As with the $17 million level, the program was arrived at by eliminating some components of the program altogether, and by scaling down others.

This level included reduction in the administrative structure to a minimum unless a different set-up is designed for administrating the program.

Components of this program would be:

		Cost
1.	Train 70 PhD's	$ 5,259,000.
2.	One major professor visit per PhD	657,000.
3.	Send 60 scientists as visiting scholars to work with US scientists	906,000.
4.	Conduct two years of on-the-job training for equipment maintenance technicians	301,000.
5.	Research management seminars in the US for 2 groups (2 visits to each) of research administrators.	414,000.
6.	Administration	4,781,000.
	TOTAL	12,322,000.

Tables 16 and 17 detail the components and costs of this program.

The reduction of the program from the $17 million to the $12 million level is as follows, with reduction listed in priority order:

1. Cut out a second group of the Station Heads/Administrators management training to the US.

   Savings: 246,000.

2. Cut out the Accountant Training Program in the US.

   Savings: 303,000.

3. Cut out the .5 FTE of a Faculty Associate. This is unnecessary with so few arrangements to be made other than student participant programs.

   Savings: 923,000.

4. Cut the number of PhD participants to 70 and cut out all second visits of major professors.

   Savings: 3,411,000.

   TOTAL $ 4,883,000.

The alternative of completely eliminating the administrative staffing for the program and allowing the trainees to go through USDA/OICD was considered. However, it costs $2,000 per student year for this. That is a total cost of $4,207,000, which is not enough extra saving to offset the benefits of having the administration support team. Some further savings on administration could be achieved on the US side by reducing the secretarial and accountant time somewhat.

Tables 18 and 19 detail the components and costs of Alternative 5.

Table 8, Alternative 1 - Base Program, No. of participants, $22 Million level

Year	Research Admin Seminars	Acctnt Seminars	PhD	Major Profs	MSc To UNBI	MSc To CIMMYT	Adv. Res. Sci.	Eqpt. Maint.	Visiting Scien-tists to US	Intro Res Methods	Research Anal & Write-Up	Visiting Profs to UNBI
1987	10	10	10	0	6	4	20	48	6	60	40	2
1988	10	10	25	10	12	4	20	48	6	60	40	2
1989	10	10	40	15	12	4	20		6	60	40	2
1990	10		45	25	12	4	20		6	50	40	2
1991	10		45	30	12	4	20		6	60	40	2
1992	10		45	30	12	4	20		6	30	40	2
1993	10		45	30	12	4	20		6	30	40	2
1994	10		30	30	12	4	20		6	30	40	2
1995	0		15	30	12	4	20		6	30	40	2
1996	0		0	0	6	4	20		6	30	40	2
Total	80	30	300	200	108	40	200	96	60	450	400	20

1] 100 PhD's to be trained.

2] 54 MSc's to be trained.

Table 9 Alternative 1 - Base Program Costs, $22 Million level

Year	Research Admin Seminars	Acctnt Seminars	PhD	Major Profs	MSc To UNBI	MSc To CIMMYT	Adv. Res. Sci.	Eqpt. Maint.	Visiting Scien-tists	Intro Res Methods	Research Anal & Write-Up	Visiting Profs to UNBI	Admin	Total
								($000)						
987	96	96	201	0	50	46	28	147	72	100	68	108	420	1,432
988	101	101	528	60	139	49	30	154	76	105	64	114	441	2,050
989	106	106	888	94	146	51	31		80	110	68	120	463	2,265
990	111		1,049	164	153	53	33		84	116	71	126	486	2,446
991	117		1,101	209	161	56	34		88	121	74	132	511	2,605
992	123		1,156	217	169	59	36		92	64	78	138	536	2,668
993	129		1,214	228	177	62	38		97	67	82	145	563	2,802
994	135		850	239	186	65	40		102	70	86	153	591	2,527
995			446	251	195	68	42		107	74	90	160	621	2,054
996				132	127	72	44		112	78	95	168	652	1,480
tal	918	303	7,432	1,595	1,630	581	355	301	911	906	770	1,364	5,704	22,445

Table 10 Alternative 2, Base Program Reduced, Number of Participants, $15 Million level

Year	Research Admin Seminars	Acctnt Seminars	PhD	Major Profs	MSc To UNBI	MSc To CIMMYT	Adv. Res. Sci.	Eqpt. Maint.	Visiting Scientists to US	Intro Res Methods	Research Anal & Write-Up	Visiting Profs
1987	10	10	6	0	4	2	20	48	6	30	40	0
1988	10	10	15	6	8	2	20	48	6	30	40	0
1989	10	0	24	9	8	2	0		6	30	40	0
1990	10		27	9	8	2	20		6	30	40	0
1991	0		27	9	8	2	0		6	30	40	0
1992	0		27	9	8	2	20		6	30	40	0
1993	0		27	9	8	2	0		6	20	0	0
1994	0		18	9	8	2	20		6	30	0	0
1995	0		9	0	8	2	0		6	30	0	0
1996	0		0	0	4	2	20		6	0	0	0
Total	40	20	180	60	72	20	120	96	60	270	240	0

1] 60 PhD's to be trained.
2] 36 MSc's to be trained.
3] Visits reduced to one per student instead of two as in $22 Million level

Table 11 Alternative 2 Base program, Reduced level, Cost at $15 Million level

Year	Research Admin Seminars	Acctnt Seminars	PhD	Major Profs	MSc To UNBI	MSc To CIMMYT	Adv. Res. Sci.	Eqpt. Maint.	Visiting Scien-tists	Intro Res Methods	Research Anal & Write-Up	Visiting Profs to UNBI	Admin	Total
								($000)						
1987	96	96	121	0	34	23	28	147	72	50	62	0	420	1,149
1988	101	101	317	36	93	24	30	154	76	53	64	0	441	1,490
1989	106		533	56	97	25			80	55	68	0	463	1,483
1990	111		629	59	102	26	33		84	58	71	0	486	1,659
1991			661	62	107	28			88	61	74	0	511	1,592
1992			694	65	113	29	36		92	64	78	0	536	1,707
1993			729	68	118	31			97	67		0	563	1,673
1994			510	71	124	33	40		102	70		0	591	1,541
1995			268	75	130	34			107	74		0	621	1,309
1996				0	85	36	44		112	78		0	652	1,007
otal	414	197	4,462	492	1,003	289	211	301	910	630	417	0	5,284	14,610

Table 12 Alternative 3 Maize & Sorghum program. Number of participants. $17 Million level

Year	Research Admin Seminars	Acctnt Seminars	PhD	Major Profs	MSc To UNBI	MSc To CIMMYT	Adv. Res. Sci.	Eqpt. Maint.	Visiting Scientists to US	Intro Res Methods	Research Anal & Write-Up	Visiting Profs to UNBI
1987	10	10	4	0	13	2	20	48	6	30	40	0
1988	10	10	12	4	13	2	20	48	6	30	40	0
1989	10		20	8	26	2	0		6	30	40	0
1990	10		24	8	26	2	20		6	30	40	0
1991			24	8	26	2	0		6	30	40	0
1992			24	8	26	2	20		6	30	40	0
1993			24	8	26	2	0		6	30	0	0
1994			24	8	26	2	20		6	30	0	0
1995			16	8	26	2	0		6	30	0	0
1996			8	0	11	2	20		6	0	0	0
Total	40	20	180	60	230	20	120	96	60	270	240	0

1] 60 PhD's to be trained

2] 115 MSc's to be trained

Table 13 Alternative 3 Maize & Sorghum Program Cost, $17 Million level

Year	Research Admin Seminars	Acctnt Seminars	PhD	Major Profs	MSc To UNBI	MSc To CIMMYT	Adv. Res. Sci.	Eqpt. Maint.	Visiting Scien-tists	Intro Res Methods	Research Anal & Write-Up	Visiting Profs to UNBI	Admin	Total
								($000)						
1987	96	96	81	0	109	23	28	147	72	50	62	0	420	1,184
1988	101	101	254	23	301	24	30	154	76	53	64	0	441	1,622
1989	106		444	48	316	25	0		80	55	68	0	463	1,605
1990	111		559	50	331	26	33		84	58	71	0	486	1,809
1991			587	53	348	28	0		88	61	74	0	511	1,750
1992			616	55	366	29	36		92	64	78	0	536	1,872
1993			647	58	384	31	0		97	67	-	0	563	1,847
1994			680	61	403	33	40		102	70	-	0	591	1,980
1995			476	64	424	34	0		107	74	-	0	621	1,800
1996			250		249	36	44		112	78	-	0	652	1,421
Total	414	197	4,594	412	3,231	289	211	301	910	630	417		5,284	16,890

Table 14 Alternative 4 Reduced Base Program. Participants, $17 Million level

Year	Research Admin Seminars	Acctnt Seminars	PhD	Major Profs	MSc To UNBI	MSc To CIMMYT	Adv. Res. Sci.	Eqpt. Maint.	Visiting Scien-tists To US	Intro Res Methods	Research Anal & Write-Up	Visiting Profs
1987	10	10	10	0	0	0	20	48	6	0	0	0
1988	10	10	25	10	0	0	20	48	6	0	0	0
1989	10	10	40	15	0	0	20		6	0	0	0
1990	10		45	25	0	0	20		6	0	0	0
1991	10		45	30	0	0	20		6	0	0	0
1992	0		45	30	0	0	20		6	0	0	0
1993	10		45	30	0	0	20		6	0	0	0
1994	0		30	30	0	0	20		6	0	0	0
1995	0		15	30	0	0	20		6	0	0	0
1996	0		0	0	0	0	20		6	0	0	0
Total	60	30	300	200	0	0	200	96	60	0	0	0

1] Total = 100 PhD Trainees to be trained

Table 15 Alternative 4 Reduced base Costs at $17 Million level

Year	Research Admin Seminars	Acctnt Seminars	PhD	Major Profs	MSc To UNBI	MSc To CIMMYT	Adv. Res. Sci.	Eqpt. Maint.	Visiting Scien-tists	Intro Res Methods	Research Anal & Write-Up	Visiting Profs	Admin	Total
								($000)						
1987	96	96	201	0	0	0	28	147	72	0	0	0	420	1,060
1988	101	101	528	60	0	0	30	154	76	0	0	0	441	1,491
1989	106	106	888	94	0	0	31		80	0	0	0	463	1,768
1990	111		1,049	164	0	0	33		84	0	0	0	486	1,927
1991	117		1,101	209	0	0	34		88	0	0	0	511	2,060
1992	123		1,156	217	0	0	36		92	0	0	0	536	2,037
1993	129		1,214	228	0	0	38		97	0	0	0	563	2,269
1994	135		850	239	0	0	40		102	0	0	0	591	1,822
1995			446	251	0	0	42		107	0	0	0	621	1,467
1996				132	0	0	44		112	0	0	0	652	940
Total	918	303	7,432	1,595			355	301	911				5,704	16,841

Table 16, Alternative 5, Much Reduced Base Program. Participants, $12 Million level

Year	Research Admin Seminars	Acctnt Seminars	PhD	Major Profs	MSc To UNBI	MSc To CIMMYT	Adv. Res. Sci.	Eqpt. Maint.	Visiting Scientists to US	Intro Res Methods	Research Anal & Write-Up
1987	10	10	5	0	0	0	0	48	6	0	0
1988	10	10	10	5	0	0	0	48	6	0	0
1989	10	10	20	5	0	0	0		6	0	0
1990	10		25	10	0	0	0		6	0	0
1991	0		30	10	0	0	0		6	0	0
1992	0		30	10	0	0	0		6	0	0
1993	0		30	10	0	0	0		6	0	0
1994	0		30	10	0	0	0		6	0	0
1995	0		20	10	0	0	0		6	0	0
1996	0		10	0	0	0	0		6	0	0
Total	40	30	210	70				96	60		

1] 70 PhD's to be trained.

Table 17 Alternative 5 Much Reduced Base Cost $12 Million level

Year	Research Admin Seminars	Acctnt Seminars	PhD	Major Profs	MSc To UNBI	MSc To CIMMYT	Adv. Res. Sci.	Eqpt. Maint.	Visiting Scien-tists	Intro Res Methods	Research Anal & Write-Up	Visiting Profs	Admin	Total
			($000)											
1987	96	0	101	29	0	0	0	147	72	0	0	0	380	825
1988	101	0	211	30	0	0	0	154	76	0	0	0	399	971
1989	106	0	444	63	0	0	0		80	0	0	0	419	1,112
1990	111		582	66	0	0	0		84	0	0	0	440	1,283
1991			734	69	0	0	0		88	0	0	0	462	1,353
1992			771	72	0	0	0		92	0	0	0	485	1,420
1993			809	76	0	0	0		97	0	0	0	509	1,491
1994			700	80	0	0	0		102	0	0	0	535	1,417
1995			595	84	0	0	0		107	0	0	0	562	1,348
1996			312	88	0	0	0		112	0	0	0	590	1,102
Total	414		5,259	657				301	906				4,781	12,322

Placement Prospects for MSc and PhD Participants in the NARS

1. PhD's - As of 1986 there is an average of less than one PhD for each of the 24 research stations being proposed. If the proposal for training 100 PhD's recommended in this report were adopted, (10 per year plus the 8 per year trained) there would still be only about 125 PhD's in the NARS at the end of 1996. If the 100 additional were divided among the eleven research stations in crop production (see annex ___) there would be a critical mass of about 9 per station.

   Each station involves an average of 8 scientific disciplines in its program. Therefore this is about one Phd per discipline per station engaged in crops production research.

   The fact that the pay scale and research support funds are at the present inadequate to hold PhDs at the research stations does not negate their need.

2. MSc's There can be no question that the NARS can accommodate all the MSc's who will be trained. Upon returning to their station they will return to their original positions, better trained and more productive..

The Available Pool of Candidates

1. For MSc training. There are currently 288 BSc's in research officer positions in the NARS. There are also about 300 technical officers in the system with Diplomas from Egerton College, or Jomo Kenyatta College of Agriculture. Experience has shown the diplomates compete favorably with the BSc's when they are trained in the United States. The program simply takes a little longer for the diplomates - about 3 year compared to 2 1/2 for the BSc. The diplomate must first get a BSc, which takes 1 1/2 years in the U.S., then the MSc which takes another 1 1/2 to 2 years.

   Consequently the pool from which to draw MSc candidates is very large with plenty of qualified people.

2. For PhD Training

   Some people have a feeling that the pool of candidates for PhD participant training is limited. They believe it will be hard to

fill participant slots because 1) the MSc's in the system now are either too old or not qualified to go on for the PhD or 2) the research station cannot afford to let them be away for three years.

Therefore, they say, it might not be possible to find participants. This has been the case with numerous programs.

First there were only 80 MSc's in crop production discipline in 1986 and 23 of them were away for PhD training. At the present time, it may not be possible to find an additional 10 who would be accepted for training in good agronomy, plant pathology, entomology, soils, agricultural engineering or agricultural economics departments in the United States. However, in two more years, by 1988, there will be an additional 39 newly trained MSc's in the crop production. Many of these should qualify for PhD training.

If one wished to assume a very conservative posture on this issue, he could start up the PhD program slowly for 2 or 3 years, then send larger numbers for training in the third through 8th year of the project.

Drs Fenly and Dunbar visited personally with 14 newly returned MSc's at the Kiboko Range Research Station. One of these is returning to Texas A&M in the summer of 1986 for his PhD in Veterinary Medicine. At least 4 or 5 more are qualified and would like to go as soon as possible. And Dr. Benson Woie, head of the Station would like to send them. He wants a PhD to head up each of the 8 areas of research at the station. Although we were not able to talk with other station heads, we believe the situation would be the same there.

Impact of Removal of Scientists During Training

1. BSc's for training to the MSc level.

Most BSc's in the NARS do not have minimum training required to do agricultural research. Consequently many if not most are not very productive.

Therefore sending up to 40 per year for MSc training would have a minimal effect on the productivity of the system. In the second year, there would be 80 away from the program. But in the 3rd year,

the first 40 would be returning, and would be more productive. So by about the 4th year, the net productivity of the system should begin to show a steady increase. This would continue throughout the program.

With regard to the question "Can the stations spare them?", they can hardly afford not to. The long run gain in productivity certainly far outweighs the short term loss. Furthermore there are about 25 new MSc's returning to the crop production system each year. They can fill in for the others while they are away for training.

2. MSc's for Training to the PhD Level.

There is no way to take a productive MSc who is qualified to work on a PhD out of the NARS without temporarily reducing the output of the station. But there is also no way to train MSc's for the PhD without taking them out of the system for 3 years.

The real question then becomes "how can this cost be minimized in order to achieve the longer run net gains?"

As mentioned above, there are currently about 25 new MSc's being returned to the crop production system each year. This provides a back-up pool of people to take over the work of the MSc's who are away getting their PhD's. This procedure is used all the time by department heads to fill in while scientists are away for short periods of time.

As with the MSc program, in 3 years the PhD's will begin returning to their posts. The increase in productivity of those who return will be a further offset to the losses in productivity of those who are away.

A second way to reduce this impact is to bring in foreign technical assistants to fill in for key positions. This is the traditional way and is moderately successful. However, it should only be used for critical positions such as, say, maize breeding.

The one main reason for this is the high cost of the technicians costs $160,000 or more per year to maintain a technical assistance person in the field. IT costs $20,000 a year for a PhD trainee. Therefore 8 PhD or MSc trainees can be maintained in the United States for the cost of one technical assistance person.

With limited budgets a hard look should be taken at this problem before putting TA's into the program at the expense of MSc & PhD training.

Trainee Retention in the Kenya Agricultural Research System

The following questions have been asked concerning the training program:

1. What has happened to the several hundred Kenyans who have been trained by AID?
2. How many have employment appropriate to this training?
3. How many Government employees have moved to the private sector and what are the effects of these transfers?
4. How many did not return to Kenya?
5. How many did not return to assigned jobs?

Statistical analysis and complete records to give finite answers to these questions are not available. However, several partial analyses provide indicators that these problems may not be as serious as they seem.

Regarding question one, "where are they?" many, trainees' names and positions are found on employment rolls in the universities, colleges, training institutes, and the agricultural research and extension system. The Acting Principal at Egerton College received his PHD at the University of Florida. The Dean of the Faculty of Agriculture at the University of Nairobi received his PhD at Cornell University. Thirty-one with PhDs and three with MSc's from the United States are on the Faculty of Agriculture (including animal production) at the University of Nairobi. Of the faculty at Egerton College, 45 out of 154 are MSc's or PhDs trained in the U.S. Several PhDs from the U.S. are in administrative positions in the NARS.

Although the transition is not complete, Kenyans with post graduate degrees are gradually replacing the seasoned expatriates who were in the system a decade ago.

Question 2 and 5, "Do trainees return to their employment in relation to the jobs and is their employment appropriate to their training," are answered together. The answer to both questions a qualified "yes". They do return to their jobs. However, there is more mobility in the system than there was a few years ago, so a substantial number move from these jobs to better ones within the Agricultural Research, Education, and

Extension systems some do move to private industry. Heads of departments in the agricultural education system and research station heads indicated that they must recruit people to fill various positions vacated by retirement or by people who have moved upward in the system. Numerous people leave the positions they held when they were trained to take advantage of these better opportunities. For example, of the 21 people trained for the National Range Research Station at Kiboko, five have left for positions where they can use their training more effectively, but this station head says they are all still within the public Research/Education system. Of the people trained for Egerton College, very few have left their positions.

Question three is "How many government employees have moved to the private sector and what are the effects of these transfers." This mobility does take place and regretably there are no statistics on the percentage. For the people with special knowledge or skills that it needs, private industry in Kenya pays more than government or college and university work, as it does elsewhere in the world. This mobility is not a total loss to agriculture because it often helps private industry to become more efficient in producing and distributing inputs for agricultural production. This helps improve Kenya agriculture, which is the ultimate goal.

Apparently there are not too many people with MSc's or PhDs who transfer to private industry. A manpower survey conducted by USAID in late 1982 indicated that there was only one PhD degree holder and five MSc's in private industry and the parastatals in Kenya.

Concerning question 4, "How many trainees did not return to Kenya," the answer seem quite positive. IN response to this question Mrs. Lilian Kimani, who was responsible for the overseas trainee program of the Ministry of Agriculture from 1979 to 1986, said "there was only one whom we were not able to get back. In the large Range Management Training Program at Texas A&M, one student apparently did not return to Kenya, but he had flunked out of the program early, so the loss of him in dollar cost was minimal.

3. Heads of stations or departments nominate qualified people.
4. The ministerial training committee selects people for the training positions from those nominated.
   It insists on having at least 3 nominees of each position. The membership and this committee is broad based representing all parts of the ministry.
5. When a person has been selected, the secretary of the training committee notifies the training institution and the individual concerned.
6. The trainee is released to go to ministry to fill out the necessary forms.
7. Completed forms go to the Directorate of Personnel, Presidents Office.
8. The Presidents Office forwards the nomination to USAID.
9. From this point on USAID procedures are followed for approval of trainee, commitment of funds, placement of trainees preparation of predeparture paper, briefing at USAID, Kenya and briefing in Washington, D.C.

ADMINISTRATION OF THE PROJECT

Administering the training program

The question has been raised as to the most effective contracting arrangement to implement the training phase of this project. One key factor in this decision is that it is an education and training project for research - not a research project. Another key is that the primary need is to raise the level of excellence of the manpower who will man the Agricultural Research System of Kenya for the year 2000 and beyond.

In fulfilling the contract, the contractor must have the respect and cooperation of the land grant university community. This is true whether the contractor is a University, a Consortium, Winrock International or a private entity.

It is not possible to predetermine which of the above organizations, or combination of organizations, will be most qualified to carry out these responsibilities. This will have to wait upon the bidding process.

In any event, a land grant university or universities will have to be involved at some point if the project is to succeed. Functions which will have to be performed include:

a. Provide a highly qualified, experienced person to be project leader, stationed in Kenya.

b. Provide a competent project facilitator/coordinator in the U.S. who will assist the project leader in placing students, coordinate with deans and department heads and faculties involved in training and provide other back up for students.

c. Provide necessary administrative and technical support to the project leader stationed in Kenya.

d. Placement of students in those universities and departments best qualified to fulfill their training needs.

e. Organize and provide academic counseling and personal assistance to trainees.

f. Personal follow-up with each student and his faculty advisor to monitor progress and identify problems or opportunities to keep - this includes a semiannual written report of progress to be submitted to the project leader and Kenya government officials.

g. Provide for students to do their thesis research in Kenya - includes planning and organizing the thesis research in Kenya with data collection in Kenya and return to the United States for data analysis, thesis writing and final examination.

h. Provide for research progress follow-up with students after they have completed their degrees by their major professors.

i. Find the best possible qualified personnel to assist with administrative training traveling seminars, senior scientist training, visiting scientists and other university related technical assistance phases of the project.

j. Preparing semiannual and annual reports required for the project.

Staffing for the Administration:

1. Project Leader - to be stationed in Nairobi:

a) Cooperates and advises with MOALD officials in selection of trainees.

b) Maintains liaison with technical support personnel to help identify potential trainees.

c) Works with U.S. university project facilitator/coordinator in placing student in appropriate departments and programs of U.S. universities and in arranging informal training seminars in the U.S. for administration and other Kenyans.

d) Provides necessary assistance and support to MOALD and USAID for sending students to IARCs and/or third countries for training.

e) Consults with and advises MOALD, and other responsible officials in organizing U.S. participation and participants for informal training and workshops.

f) Supervise final preparation and mailing trainee documents to the U.S.

g) Maintains liaison with all entities involved with the project.

2. Project facilitator/coordinator

a) Provides assistance to team leader in placing students in universities and departments most able to meet student training needs.

b) Represents the team leader in all matters of relationships with U.S. agricultural universities.

c) Provides quarterly reports of programs on all aspects of the training program to:

i) the project leader;

ii) administrator of the U.S. university or other entity responsible for the project, and

iii) USAID/Kenya.

d) Organize a bi-monthly "coordination meeting" with key university administrators, deans and department heads, faculty advisors and others to review progress and identify problems and develop solutions connected with the ongoing success of the project.

e) Personally visit all participants and their faculty advisors (al all universities) semiannually and prepare a written progress for the project leader, USAID/Kenya and Kenya MOALD.

3. Half-time support person:

a) Find qualified consultants and provide logistical support for traveling seminar teams of administrators and accountants.

b) Identifies U.S. scientists with whom the visiting scientists could work and facilitate their program.

c) Identifies key scientists each year to send to Kenya for the Senior Scientist training series.

d) Locates two visiting professors per year for the University of Nairobi.

This person should be a scientist/scholar/administrator type who is able to contact a wide range of administration and their faculty to make this a quality program.

4. Project administrative staff support:

a) Accountant; 5 FTE to perform all budgeting and accounting work for the project

b) secretarial:

1.0 FTE for project leader

.8 FTE for facilitator/coordinator

.2 FTE for administrator

Annex 1.

University of Nairobi Potential For Training MSc and PhD Degree Holders

Current Situation

The Faculty of Agriculture and field research station were established 16 years ago, 1970. The Faculty now has seven Department: Agricultural Economics, Agricultural Engineering, Food Science and Technology, Soil Science, Crop Science, Forestry and Range Management, plus a Department of Animal Production in the Faculty of Veterinary Medicine.

In 1973, the Faculty introduced MSc degree training program in Agronomy, Animal Production, Plant Pathology, Agricultural Economics, Soil Science, Plant Breeding, Food Science, Agricultural Engineering, and a post graduate diploma in Irrigation and Soil Conservation.

The number of undergraduate students receiving BSc degrees has increased to about 225 per year in agriculture, 95 in veterinary medicine. About 30 students are receiving MSc's in agr each year. Over 1/2 of these are in crop science. Eight to ten MSc's in veterinary medicine. About 5 or 6 PhD degrees are granted each year in Agr and Vet. Medicine.

Post graduate programs have been developed primarily within the resource base allocated for undergraduate training. Recurrent funding for agricultural research has been severely limited. Research funding has come largely on a project-by-project basis from Agencies of the Ministry and from foreign donors, such as Rockerfeller Foundation, the

Netherlands Government, the Government of Switzerland, World Bank, and other countries and agencies. Post graduate fellowships have been provided to student by USAID and other donor agencies.

There is not enough recurrent cost funding to provide the function for an effective, on-going MSc and PhD training program. Such programs are built on a solid base of on-going research programs by the institution involved in the training. Post graduate students are then involved in the research for their thesis research.

The ISNAR/University of Nairobi Task Force Committee on Strengthening Post Graduate Research Training in Agriculture and Veterinary Medicine, says "...post graduate training at the University of Nairobi has remained at a fledgling stage, with limited resources, estimated at about 10 percent of total normal recurrent and capital allocations, devoted to sustaining the MSc (course work and thesis) and the limited number of PhD candidates (thesis only) who can be supervised by the senior staff."

Despite these limitations, the Faculty in agriculture are producing about 30 MSc degree holders each year. Over half of these is inthe crop science department.

The Faculty does maintain close collaboration with the Ministry of Agriculture and Livestock Development and the Ministry of Environment and Natural Resources, with Research Institutes, and the National Council for Science and Technology.

Capabilities of the University of Nairobi for Training MSc and PhD Students

In 1984/85 the University of Nairobi had a total of 81 faculty in Agriculture (including animal production) and 70 in Veterinary Medicine. Of the faculty in Agriculture, 52 (two-thirds) had PhD degrees and 17 MSc's. There were only three with BSc's. Seven of the 17 MSc's and one of the three BSc's were on study leave. This means that very shortly 59 of the 81 faculty in Agriculture will have PhDs.

The PhDs are from a wide range of well known and highly respected universities in the United States, Great Britain and elsewhere. These faculty members are to do quality research in agriculture and to conduct MSc and PhD graduate training.

The major constraint to their conduct of agricultural research is a shortage of recurrent cost funds to implement the research.

TABLE 13

Educational Level, Faculty (Academic Staff) of the University of Nairobi, 1984/85. 1/

Department	Total	PhD	MSc	Other	US Trained PhDs
Faculty in Agriculture					
Agric. Economics	10	9	1	-	6
Agric. Engineering	12	3	7	2	-
Crop Science	17	14	3	-	11
Soil Science	8	5	3	-	4
Range Management	4	3	1	-	3
Food Science & Tech.	12	9	3	-	1
Total	63	43	18	2	25
Faculty of Veterinary Medicine					
Animal Production	14	9	5	-	3
Clinical Studies	15	5	5	5	1
Pub. Hlth & Toxic.	14	4	6	4	-
Anatomy	7	3	-	4	-
Pathology & Microbiology	18	4	9	5	3
Vet. Physiology	9	6	1	2	1
Total	77	31	26	18	8

1/ Calculated from lists in the Univ. of Nairobi Calender, 1984/85

Total post graduate student enrollment at the University of Nairobi in 1983/84 was, 1) for agriculture 145; 2) for Veterinary Medicine (including Animal Production) 61.

The Faculty of Agriculture at the University of Nairobi is a key national resource. It has the capacity to train much of the scientific manpower for the improvement of agriculture so important to the future of the people of Kenya.

Of the 31 faculty in disciplines associated with crop production five out of six have PhDs. This capacity is continuing to grow in numbers, experience and capability each year. If it is provided the necessary recurrent cost support it will also have the capacity to fulfill its responsibility to the people of Kenya.

The Faculty of Agriculture (as well as in Veterinary Medicine) is complemented by well trained, competent faculties to Botany, Zoology (which includes Entomology), Mathematics, Chemistry, Physics and Geology. Over half of them have PhDs, the remainder have MSc's.

On going MSc and PhD programs have been established in all the areas of agricultural science. In 1986, the output of PhD's at the University of Nairobi was about 10. Over time this capacity will increase and must if the University of Nairobi is to serve Kenya as the center of training for scientists to supply the research, teaching, extension and private industry needs of Kenya.

The University has wisely adopted a high significant and important policy to facilitate thesis research for both MSc and PhD degrees. This policy allows for the appointment of a second supervisor for the MSc or PhD student. This supervisor may be a qualified faculty member at one of the colleges or a

qualified scientist in the agricultural research system. He or she may be an expatriate as well. The procedure for appointment of the second supervisor is clearly spelled out in the 1984/85 Calendar, University of Nairobi, pp 87 and 92.

This policy has several significant advantages including:

-- Makes it possible for a student to do his thesis research at his regularly assigned work post.

-- Allows the student to do thesis research which contributes to the improvement of agriculture in Kenya.

-- Builds a closer working relationship between the University of Nairobi, people in the agricultural research system, the colleges, and/or private enterprise. This has many positive long-term benefits.

This policy does require proper commitment from not only the second supervisor, but also from the administrators of the research station, college or private business firm. This is necessary to insure that the candidate completes his/her thesis research in a reasonable time.

One example of how this policy is working successfully exists at Egerton College. The Animal Science Department head is the second supervisor for one of his faculty members who is a candidate for a PhD in Animal Nutrition at the University of Nairobi. He has the necessary qualifications and his own commitment as well as that of Egerton College. Positive benefits from this arrangement will accrue to the student, to

the University of Nairobi, Egerton College, and to the production of scientific research for the benefit of agriculture in Kenya.

Strong critisism has been registered concerning the slowness in awarding of degrees. Much of this has to do with the fact that the thesis must be submitted to an outside reviewer which may take several months to a year. For all practical purposes, however, when the student's advisor signs his approval, the student has his thesis work completed and can go back to his regular position.

Table 14 Past and Projected Supply of Agricultural and Veterinary Graduates and Postgraduates from the University of Nairobi, 1971 to 1987.

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

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

Annex 2.

Contributions of Egerton College to the Training of MSc and PhD Students

The emphasis of Egerton College educational programs has been to train diplomates, primarily for positions in the extension service. As the college has grown, the number of diplomates trained has increased and the quality of their training has improved. In 1986, Egerton College will admit the first class of 4-year BSc degree students to be graduated in 1990. It does not yet grant MSc or PhD degrees.

It does, however, have a modest research program and a limited number of faculty qualified to become the second supervisors at the University of Nairobi to assist MSc or PhD candidates with their thesis research. This is especially helpful to Egerton College faculty who are pursuing a degree from the University of Nairobi.

Note the example listed under the discussion of the University of Nairobi.

Annex 3.

Format for Participant Training

The following format for participant training was suggested by the Texas A&M, Winrock International team responsible for the Range Research Participant Training Program.

Academic Coordinators

1. The training institution, whether the primary or subcontractor, should provide a member for the in-country training team. This individual should be of faculty status.

2. There should be a U.S. academic coordinator to coordinate activities and academic programs of participants, across Universities when several institutions are involved.

3. If a University has a large number of participants, an on-campus academic coordinator should be designated to facilitate participant programs.

NOTE: The purpose of these coordinators is to facilitate the screening, selection, and academic and associated research program development. These individuals should be involved at the on-set of the project.

Academic Advisors

Major advisors should become familiar with the in-country research environment of their students and when necessary visit the research site.

Student Training

1. Upon selection, the participants should receive University orientation by the in-country academic representative.

2. The student participants should receive formal graduate training at the U.S. university prior to in-country research initiation for their thesis/dissertation requirements.

3. The research advisor should be present in-country at the time of the student's research initiation not only to coordinate the student's research project but to develop a liaison with on-site contract personnel to serve as research advisors in the advisor's absence. Advisor in-country stays should be 2-4 weeks duration.

4. Upon completion of in-country data collection, the participants should return to the academic institutions for: 1) data analysis, 2) thesis/dissertation writing and 3) coursework completion, all under supervision of major advisor.

Follow-on Procedure

1. Within 4-6 months after the participant completes his degree requirements, either the advisor or the academic coordinator/on-site academic representatives should make an in-country to provide continuity from short-term thesis/dissertation research to long-term research that address relevant issues in their country. Where several advisors and students have been involved, a general meeting should be held in-country to assist in research program development.

2. Where appropriate, long term research relationships should be facilitated between individuals in the training institution and participants. (2-5 years depending on relevancy of the research).

This format was prepared by:

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Annex 4

Estimated Numbers of MSc's and
PhD's in NARS, 1996 under
Alternative Training Rates.

Alternative rates of training included are:

1. Present rate of training (1986).
2. Task Force plan.
3. Training a total of 20 PhD's and 40 MSc's per year.

Table 4-1

Table ____. PhD Manpower in NARS in 1996, Assuming Training at 1986 Rates (Eight Per Year.)

	Number PhDs Jan 1	Less 4% Attrition	New PhDs	Net No. in System
1986	16	1	8	23
1987	23	1	8	30
1988	30	1	8	37
1989	37	1	8	44
1990	44	2	8	50
1991	50	2	8	56
1992	56	2	8	62
1993	62	2	8	68
1994	68	3	8	73
1995	73	3	8	78
1996	78	3	8	83

Flow Chart, PhD Training, at 1986 rate.

	Number To Start	Number in Training				Number To Recv PhDs
		1st Yr	2nd Yr	3rd Yr	Total	
1986/87	8	8	8	8	24	8
1987/88	8	8	8	8	24	8
1988/89	8	8	8	8	24	8
1989/90	8	8	8	8	24	8
1990/91	8	8	8	8	24	8
1991/92	8	8	8	8	24	8
1992/93	8	8	8	8	24	8
1993/94	8	8	8	8	24	8
1994/95	8	8	8	8	24	8
1995/96	8	8	8	8	24	8
1996/97	8	8	8	8	24	8

Table 4-2

MSc Manpower; NARS, If Training Achieved at 1986 Rate (30 Per Year)

	Number MSc's	Number To PhD Training	Attrition Rate (4%)	New MSc's	Number at End of Year
1986	192	8	8	27	203
1987	206	8	8	27	220
1988	220	8	9	27	238
1989	238	8	9	27	246
1990	246	8	10	27	258
1991	258	8	10	27	270
1992	270	8	11	27	281
1993	281	8	11	21	292
1994	292	8	12	27	302
1995	302	8	12	27	312
1996	312	8	12	27	322

Flowchart, MSc Training, 1986 Rate

	Number To Start	Number In Training 1st Year	2nd Year	Total	Number To Receive MSc's
1986/87	30	30	28	58	27
1987/88	30	30	28	58	27
1988/89	30	30	28	58	27
1989/90	30	30	28	58	27
1990/91	30	30	28	58	27
1991/92	30	30	28	58	27
1992/93	30	30	28	58	27
1993/94	30	30	28	58	27
1994/95	30	30	28	58	27
1995/96	30	30	28	58	27

Table 4-3

PhD Development Under Task Force Plan — Training
60 PhDs in the First Five years, Then Reverting to 1986 Rate
(Task Force Proposal)

	Number Jan 1	Loss	New PhDs	Number End of Year
1986	16	1	8	23
1987	23	1	8	30
1988	30	1	8	37
1989	37	1	8	44
1990	44	2	15	57
1991	57	2	15	70
1992	70	3	15	82
1993	82	3	15	94
1994	94	4	8	98
1995	98	4	8	102
1996	102	4	8	106
1997	106	4	8	110
1998				

Flowchart, PhD Training, Task Force Rate

	Numbers To Start	Numbers in Training					No. To Receive Degrees
		Regular	1st Yr	2nd Yr	3rd Yr	Total	
1986/87	8	8	8	8	8	24	8
1987/88	15	15	15	8	8	31	8
1988/89	15	15	15	15	8	38	8
1989/90	15	15	15	15	15	45	15
1990/91	15	15	15	15	15	45	15
1991/92	8	8	8	15	15	38	15
1992/93	8	8	8	8	15	31	15
1993/94	8	8	8	8	8	24	8
1994/95	8	8	8	8	8	24	8
1995/96	8	8	8	8	8	24	8
1996/97	8	8	8	8	8	24	8

Table 4-4

MSc Development Under Task Force Plan, Training 300 MSc's In First Five Years, Then Reverting to 1986 Rate of 30 Per Year

	Number Jan 1	To PhD	Loss (4%)	Added MSc	Not In System End Of Year
1986	192	8	8	30	206
1987	206	15	8	30	213
1988	213	15	8	75	265
1989	265	15	10	75	315
1990	315	15	12	75	363
1991	363	8	14	75	416
1992	416	8	15	30	423
1993	423	8	15	30	430
1994	430	8	15	30	437
1995	437	8	15	30	443
1996	443	8	16	30	449
1997	449	8	16	30	455

Flowchart, MSc Training, Task Force Rate

	Number To Start	Number In Training 1st Year	2nd Year	Total	Number to Receive Degrees
1986/87	30	30	30	60	30
1987/88	75	75	30	105	30
1988/89	75	75	75	150	75
1989/90	75	75	75	150	75
1990/91	75	75	75	150	75
1991/92	30	30	75	105	75
1992/93	30	30	30	60	30
1993/94	30	30	30	60	30
1994/95	30	30	30	60	35
1995/96	30	30	30	60	35

Table 4-5

MSc Development for 1996 With 40 To Be Started Each Year (assuming 20 PhDs Start)

	Number MSc's Jan 1	Net Number To PhD Trg 1/	Attrition Rate (4%)	New MSc's	Number At End Of Year
1986	192	8	8	26	206
1987	206	17	8	36	217
1988	217	17	8	36	228
1989	228	17	8	36	239
1990	239	17	9	36	249
1991	249	17	10	36	258
1992	258	17	10	36	267
1993	267	17	10	36	276
1994	276	17	11	36	284
1995	284	17	11	36	292
1996	292	17	12	36	299

1/ Number who start (20) minus an estimated 3 who will drop out of the program each year.

Flowchart — MSc Training, 40 per year

	Number To Start	Number In Training 1st Year	2nd Year	Total	Number To Receive MSc's
1986/87	40	40	28 1/	68	30 2/
1987/88	40	40	38	78	36
1988/89	40	40	38	78	36
1989/90	40	40	38	78	36
1990/91	40	40	38	78	36
1991/92	40	40	38	78	36
1992/93	40	40	38	78	36
1993/94	40	40	38	78	36
1994/95	40	40	38	78	36
1995/96	40	40	38	78	36

1/ Assumes 2 drop outs each year from the original 40 who start.
2/ Based on 30 starts per year.

Table 4-6

PhD Development to 1996, Assuming 20 To Be Started Each Year

	Number MSc's Jan 1	Attrition Rate (4%)	New PhDs	Number At End Of Year
1986	16			
1987	23	1	8	23
1988	31	1	8	31
1989	49	1	17	49
1990	64	2	17	64
1991	79	2	17	79
1992	83	3	17	83
1993	97	3	17	97
1994	110	4	17	110
1995	123	4	17	123
1996	135	5	17	135
		6	17	146

Flow Chart, PhD Training, 20 Per Year

	Number To Start	Numnber In Training 1st Yr	2nd Yr	3rd Yr	Total	Number To Receive PhDs 1/
1986/87	20	20	8	6	33	8
1987/88	20	20	19	6	45	8
1988/89	20	20	19	18	57	17
1989/90	20	20	19	18	57	17
1990/91	20	20	19	18	57	17
1991/92	20	20	19	18	57	17
1992/93	20	20	19	18	57	17
1993/94	20	20	19	18	57	17
1994/95	20	20	19	18	57	17
1995/96	20	20	19	18	57	17

1/ Assumes only 17 people complete PhDs of the original 20 who start.

Annex 5.

Budget Building Data

This Annex contains the basic data used in budgeting the costs for each element of the training program. Cost per year are calculated at a compounded inflation rate of 5 percent per year, beginning with 1987 over 1986.

Budgets and Schedules of Trainees included are for:

1. Research Administrator (Manager) Seminar.
2. PhD Student Training (US), 100 level.
3. Scheduled number of visits by Major Professors (two visits each).
4. Major Professor trips to Kenya.
5. Cost of PhD student training, 70 participants.
6. Scheduled number and cost of PhD trainees, Maize and Sorghum Progra, total of 60.
7. Number and cost of Major Professors trips to Kenya, Maize and Sorghum Program, 1987-96.
8. MSc Fellowships to University of Nairobi.
9. Number and cost of MSc trainees to University of Nairobi, Maize and Sorghum Program, 1987-96 (total 115 trainees).
10. MSc Fellowships to CIMMYT.
11. Advanced Research Scientist Seminars.
12. Visiting scientists to the US.
13. Research methods training.
14. Research Analysis and Write-Up.
15. Visiting professors, University of Nairobi.
16. Cost of equipment maintenance training.
17. Contract administration.

Table 5-1

Research Administrator (Manager) Seminars

Four groups of ten to US — two sessions per group.
Traveling Seminars to US Agricultural Experiment Stations,
Six weeks per group.

Cost Per Participant	Per Day	Total
Travel to US		$2,500
in US		2,000
Per diem	$60	2,520
Prorated cost of consultant to develop Program and accompany the group (7 weeks)		
Travel in US	$2,000	
Per diem (42 days @ $60)	2,520	
Consultancy Fee (42 days @ $200)	10,920	
Total	$15,440	
Prorated for 10 participants		1,544
Out of Pocket Costs to Universities Visited:		
$6,000 for 10 participants		600
Total/Participant		$9,164

Cost of Program

Year	Cost Per Session (10 Participants)	Number of Sessions	Cost Per Year
1986	$91,640		
1987	96,222	1	$96,222
1988	101,033	1	101,033
1989	106,084	1	106,084
1990	111,389	1	111,389
1991	116,958	1	116,958
1992	122,806	1	122,806
1993	128,947	1	128,947
1994	135,394	1	135,394
Total			$918,834

Table 5-2

PhD Student Training, US, 100 level

Program — Cost of one PhD student for three years, two round trips (one is to collect the PhD thesis data).

International Travel	
First Trip (one way, paid by Kenya)	$1,500
Second Trip	3,000
Maintenance Allowance (2 years and 3 months @ $900) + Tuition	48,000
Books	800
PhD Thesis Preparation	800
Typing (or purchase typewriter)	200
Shipping books etc to Kenya	120
Training Equipment	800
Insurance (@ $40 per month)	1,000
Travel in US, and 2 weeks per diem	1,400
Total (for 3 years)	$57,500
(Divide by 3 for per year amount)	19,167 per year

Cost of Program

Year	Cost Per Trainee	No. of Trainees Per Year	Cost Per Year
1986	$19,167		
1987	20,125	10	$201,250
1988	21,131	25	528,275
1989	22,188	40	887,512
1990	23,297	45	1,048,836
1991	24,462	45	1,100,780
1992	25,685	45	1,155,819
1993	26,969	45	1,213,609
1994	28,318	30	849,527
1995	29,733	15	446,001
1996	31,220		
	Total		$7,431,609

Table 5-3

Scheduled Number of Visits By Major Professors, two visits each

First visit in second year of Students' Program.

Second visit within 6 months of Student's Completion

Assumes each Student has a separate Major Professor.

Year	Number of Visits		Total
	First Visit	Second Visit	
1987	0	0	0
1988	10	0	10
1989	15	10	25
1990	15	15	30
1991	15	15	30
1992	15	15	30
1993	15	15	30
1994	15	15	30
1995		15	30
1996		15	15
Total	100	100	200

Scheduled Number of Trainees, PhD, By Year

Year	Number of Trainees			
	1st Yr	2nd Yr	3rd Yr	Total
1987	10			10
1988	15	10		25
1989	15	15	10	40
1990	15	15	15	45
1991	15	15	15	45
1992	15	15	15	45
1993	15	15	15	45
1994		15	15	30
1995			15	15
1996				

Table 5-4

Major Professor Trips to Kenya, 100 level

Program — One month per visit, two visits, one in second year and one after completion of thesis.

Cost per visit	Per Day	Total
Travel		
To Kenya		$3,000
In-Country		500
Per Diem (30 days)	$60	1,800
Supplies		100
Total (1986)		$5,400

Cost of Program

Year	Per Visit	No. of Visits	Per Year
1986	$5,400		
1987	5,670		
1988	5,953	10	$59,530
1989	6,251	15	93,765
1990	6,564	25	164,100
1991	6,892	30	209,460
1992	7,237	30	217,110
1993	7,598	30	227,940
1994	7,978	30	239,340
1995	8,377	30	251,310
1996	8,796	15	131,940
Total	$73,166		$1,595,035
Average	$7,317		

Table 5-5

Cost of PhD Training Program at the Level of 70 Participants

Year	Trainees Per Year	Cost Per Trainee	Total Cost
1987	5	$20,125	$100,625
1988	10	21,131	211,310
1989	20	22,188	443,760
1990	25	23,297	582,425
1991	30	24,462	733,860
1992	30	25,685	770,550
1993	30	26,969	809,070
1994	30	28,318	849,523
1995	20	29,733	594,660
1996	10	31,220	312,200
		Total	$5,407,983

Scheduled No. of PhD Trainees Per Year — Total of 70 Participants

Year	1st Yr	2nd Year	3rd Year	Total
1987	5	0	0	5
1988	5	5	0	10
1989	10	5	5	20
1990	10	10	5	25
1991	10	10	10	30
1992	10	10	10	30
1993	10	10	10	30
1994	10	10	10	30
1995	0	10	10	20
1996	0	0	10	10

Table 5-6 Scheduled Number and Cost of PhD Trainees, Maize & Sorghum Program - Total of 60

Year	Number				Cost per Participant	Total Cost ($000)
	1st yr.	2nd yr.	3rd yr.	Total		
1987	4	-	-	4	$ 20,125	81
1988	8	4	-	12	21,131	254
1989	8	8	4	20	22,188	444
1990	8	8	8	24	23,297	559
1991	8	8	8	24	24,462	587
1992	8	8	8	24	25,685	616
1993	8	8	8	24	26,969	647
1994	8	8	8	24	28,318	680
1995	-	8	8	16	29,733	276
1996		-	8	8	31,220	250
						4,594

1] Assumes the base number to be trained (43) plus approximately 50% increase for attrition.

Table 5-7 Number and Cost of Major Professor Trips to Kenya, Maize and Sorghum Program 1987-96

Year	Number of Visits	Cost per Visit	Total Cost ($000)
1987			
1988	4	$ 5,670	23
1989	8	5,953	48
1990	8	6,251	50
1991	8	6,564	53
1992	8	6,892	55
1993	8	7,237	58
1994	8	7,598	61
1995	8	7,978	64
1996			
Total	60		412

Table 5-8. MSc Fellowships to University of Nairobi

Cost Per Fellowship, Per Year, 1986 = $8,000
to Train 54 MSc's
Cost per trainee for thesis research grant, 1986 = $5,000
Total cost per trainee (2 years and Thesis grant), 1986 = $21,000

Cost of Program

Year	Cost Per Trainee	Number of Trainees 1st Yr	2nd Yr	Total	Training Cost Per Year[1/]
1986	$ 8,000				
1987	8,400	6		6	$ 50,400
1988	8,820	6	6	12	105,840
1989	9,260	6	6	12	111,132
1990	9,710	6	6	12	116,687
1991	10,210	6	6	12	122,523
1992	10,720	6	6	12	128,649
1993	11,250	6	6	12	135,082
1994	11,829	6	6	12	141,836
1995	12,420	6	6	12	148,927
1996	13,030		6	6	78,187

1/ Not including thesis grants.

Thesis Grant Costs

Year	Cost Per Trainee	No. of 2nd Yr Trainees	Total	Total Costs Per Year[2/]
1986	$5,000			
1987	5,250			
1988	5,513	6	$33,078	$ 50,400
1989	5,788	6	34,728	138,918
1990	6,078	6	36,468	145,860
1991	6,381	6	38,286	153,155
1992	6,700	6	40,200	160,809
1993	7,036	6	42,216	168,849
1994	7,382	6	44,292	177,298
1995	7,757	6	46,542	186,128
1996	8,144	6	48,864	195,469
				127,051

2/ Training costs and thesis grants. $1,503,937

Table 5-9 Number and Cost of MSc Trainees to University of Nairobi, Maize and Sorghum Program, 1987-96. (Base of 77 to be trained plus 50% for attrition, total 115).

Year	Number of Trainees			Cost per Trainee Year	Cost of Trainees (w/o grant)
	1st yr.	2nd yr.	Total		($000)
1987	13	0	13	8,400	109
1988	13	13	26	8,820	229
1989	13	13	26	9,260	241
1990	13	13	26	9,710	252
1991	13	13	26	10,210	265
1992	13	13	26	10,720	279
1993	13	13	26	11,250	293
1994	13	13	26	11,819	307
1995	11	13	24	12,410	323
1996	0	11	11	13,030	143

Table 5-9 Continued

Year	MSc Thesis grants	Cost/ grant	Total cost/ grants ($000)	Cost/ training ($000)	Total Cost/ year (w/grants) ($000)
1987	0	5,250		109	109
1988	13	5,513	72	229	301
1989	13	5,788	75	241	316
1990	13	6,078	79	252	331
1991	13	6,381	83	265	348
1992	13	6,700	87	279	266
1993	13	7,036	91	293	384
1994	13	7,382	96	307	403
1995	13	7,757	101	323	424
1996	11	8,144	106	143	249
Total			790	2,441	3,231

Table 5-10

MSc Fellowships to CIMMYT For Thesis Research

Program — One Year Fellowship To Do Thesis Research at CIMMYT
Four Fellowships per year
Cost per Fellowship $11,000

Cost of Program

Year	Cost Per Fellowship	No. of Fellowships	Cost Per Year
1986	$11,000		
1987	11,550	4	$46,200
1988	12,128	4	48,510
1989	12,734	4	50,935
1990	13,370	4	53,482
1991	14,039	4	56,156
1992	14,741	4	58,964
1993	15,478	4	61,912
1994	16,252	4	65,008
1995	17,065	4	68,258
1996	17,918	4	71,671
Total		40	$581,098

Table 5-11

Advanced Research Scientists' Seminar

One Course Per Year, 4 Weeks, 20 Participants
Taught by Senior Scientists from USA

Cost Per Trainee		Per Day	Total
Travel (600 km @ $0.20)			$ 120
Full Cost Maintenance		$20	560
Supplies			50
Prorated Cost of Instructor			
Transportation			
From USA	$3,000		
In-Country	400		
Per diem 35 days/$60	2,100		
Consultancy Fee	7,800		
Subtotal	$13,300		
$13,300 prorated for 20 Trainees			665
Total Cost Per Trainee (1986)			$1,345

Cost of Program

Year	Cost Per Trainee	No. of Trainees	Cost Per Year
1986	$1,345		
1987	1,412	20	28,245
1988	1,483	20	29,657
1989	1,557	20	31,140
1990	1,635	20	32,697
1991	1,717	20	34,331
1992	1,802	20	36,048
1993	1,892	20	37,850
1994	1,987	20	39,743
1995	2,086	20	41,730
1996	2,190	20	43,817
Total			
Average	1,776		$355,208

Table 5-12

Visiting Scientists to US

Program — 6 Visiting Scientists each year to work with US Scientists in their laboratories for 6 months.

Cost Per Scientist	Per Month	Total
Transportation		
To US		$2,500
In US		1,500
Maintenance	$1,200	7,200
Books and Supplies		300
Total		$11,500

Cost of Program

Year	Cost Per Participant	Number of Participants	Cost Per Year
1986	$11,500		
1987	12,075	6	$72,450
1988	12,679	6	76,072
1989	13,313	6	79,876
1990	13,978	6	83,870
1991	14,677	6	88,063
1992	15,411	6	92,466
1993	16,182	6	97,089
1994	16,990	6	101,944
1995	17,840	6	107,041
1996	18,732	6	112,393
Total			$911,268

Table 5-13

Research Methods Training

First five years — two groups per year, 30 each, 8 weeks per group
Second five years — one group per year, 30 each, 8 weeks each

Each group requires two teachers

Cost per trainee		Per Day	Total
Travel (600 km @ $0.20)			$ 120
Full cost Maintenance (Egerton)	(56 days)	$20	1,120
Supplies			100

Prorated Time of Two Lecturers (56 days)

Per Diem ($30/day)	$1,680	per Lecturer
Travel (300 km @ $0.20)	60	"
Salary ($1,000/month)	2,000	"
Total	$3,740	per Lecturer
x 2	7,480	

Prorated for 30 Students	249
Total per Student	$1,589

Cost of Program

Year	Cost Per Student	No. Students Per Year	Total Cost Per Year
1986	$1,589		
1987	1,668	60	$100,107
1988	1,752	60	105,112
1989	1,839	60	110,368
1990	1,931	60	115,886
1991	2,028	60	121,680
1992	2,129	30	63,870
1993	2,236	30	67,063
1994	2,348	30	70,417
1995	2,465	30	73,938
1996	2,588	30	77,634
Total	$20,985	450	$906,075

Average for 10 yrs: 2,098

Table 5-14

Research Analysis and Write-Up

Two groups per year, 20 trainees per group, five weeks, 40 trainees per year, 400 total.

Cost per trainee		Per day	Total
Travel (600 km @ $.0.20)			$ 120
Full cost, maintenance, at Egerton		$20	1,120
Supplies			100
Prorated cost of Trainer			
Travel (300 km @ $0.20)	$ 60		
Per diem ($30/day x 35)	1,050		
Salary ($250/week)	1,250		
Subtotal	$2,360		
$2,360 prorated for 20 trainees			118
Total			$1,458

Cost of Program

Year	Cost Per Student	No. of Students	Cost Per Year
1986	$1,4581		
1987	1,530	40	61,326
1988	1,607	40	64,298
1989	1,681	40	67,512
1990	1,772	40	70,888
1991	1,861	40	74,432
1992	1,953	40	78,154
1993	2,052	40	82,062
1994	2,154	40	86,165
1995	2,262	40	90,473
1996	2,375	40	94,997
Total	$19,256	400	$770,219

Table 5-15

Visiting Professors To University of Nairobi

Program - Two per year, two terms (8months) each.

Cost per Professor	Per Month	Total
Travel		
Foreign		$3,000
In-Country		250
Per diem (1/2 1986 rate)	$1,300	10,400
Salary (US x 110%)		38,000
Housing (provided by the University)		
Total Cost Per Professor		$51,650

Cost per year for two Professors:

Year	Cost
1986	
1987	108,465
1988	113,888
1989	119,583
1990	125,561
1991	131,840
1992	138,432
1993	145,353
1994	152,621
1995	160,252
1996	168,265
Total	$1,364,260

Table 5-16

Cost of Equipment Maintenance Training

One Trainer for 2 years

Cost per year for Trainer		$140,000
Cost per year	=	148,000
Year		Total Cost
1987		
1988		140,000
		140,000
		280,000
Cost per trainee (48 trainees)		5,800
1987		
1988		147,000
		154,000
Total		301,000

Table 5-17

Contract Administration

Kenya

		Salaries
Project Leader	$147,000	$65,000
Adm. Assistant	15,000	15,000
Secretary	7,000	7,000
Subtotal	$169,000	$87,000

US

Assoc. Proj. Ldr (1 FTE)	$65,000	$65,000
Faculty Associate (.5 FTE)	32,000	32,000
Secretary (1 FTE)	15,000	15,000
Accountant (.5 FTE)	13,000	13,000
Subtotal	$125,000	$125,000
Total Salaries		$212,000
x 50% Overhead	106,000	106,000
Total	$400,000	

Cost Per Year

Year	$000	Year	$000
1986	$400	1992	$536
1987	420	1993	563
1988	441	1994	591
1989	463	1995	621
1990	486	1996	652
1991	511	Total	$5,072

Cost Per Year without the Faculty Associate — $362,000 for 1986.

Annex 6.

Collaborative Linkages between the Kenyan Research System and the University of Nairobi.

A. For Conducting Research:

The College of Agriculture at the University of Nairobi was first established in 1970. Its first priority was to develop a quality undergraduate BSc program which it has done. Its students are well trained in science. Unitl now the research and graduate graining programs have been minimal. The numbers of post graduate degrees turned out until 1983 was minimal.

The MSc degree program has now begun to have its impact on the educational research system however. Many of the faculty at Egerton College have their MSc degree from the University of Nairobi. Practically all the BSc degree holders and more and more of the MSc's in the NARS have their degree from the University of Nairobi.

The research program at the University has been minimal. This has been caused by two primary factors - 1) until recently faculty were not trained for research and 2) funds for recurrent costs to conduct research were estremely limited.

It should be pointed out that a substantive research program is a primary requisite for a quality graduate training program for either the MSc or PHD. In recent years, students have taken up to 5 years to get their MSc degree.

The faculty at the University is now quite well trained. Many of them have PhD's, most of which were secured in the United STates at universities with excellent agricultural research programs.

If additional funding is granted to University of Nairobi to support agricultural research, it will have a much exparded program in a very few years. Once such a program is developed, there will be more opportunities to collaborate with NARS in research. Mearnwhile there is developing a good working relationship for MSc and PhD thesis supervision by research scientists at the agricultural research stations.

As the number of scientists in NARS with post graduate degree from UNBI grows, the cooperation between the two systems will also grow - provided there is enough funding at UNBI for it to be a viable partner on the research team.