THE CONTRIBUTION OF RESEARCH AND TRAINING TO AGRICULTURAL DEVELOPMENT IN TANZANIA

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INTRODUCTION

The need to increase agricultural production is more evident now than ever before. The population is expanding at a faster rate now than the increase in the rate of agricultural production. World market prices for our agricultural products are unstable and more often fall than increase. This situation calls for an improvement in agricultural production methods and productivity. The responsibility of developing new and improved methods has been given to agricultural research and training institutions.

Besides land, labour, and capital, technology is a decisive factor in economic growth, particularly in a country such as Tanzania where the agricultural sector is predominant. The question is how to accelerate technological development in agriculture. Certainly research and training are needed; research that can tell what technological development should be the aim and how this technological development can be implemented, what theoretical and practical training should be adopted and at what level and depth. Despite the difficult and harsh conditions under which our research and training institutions have operated, they have nevertheless made progress towards the improvement of agricultural production and productivity. Some of the research results are directly applicable but most need to be adjusted to the specific conditions in the different ecological and socio-cultural areas of Tanzania. This task has been and can best be done by our national research and training institutions.

HISTORICAL BACKGROUND

During the colonial period, and for obvious reasons, activities in Tanzania were based or concentrated on the development of plantation crops such as coffee, sisal, cotton, tea and cashewnuts. Research activities focused on the same commodities. Research programmes were aimed at solving the problems facing the plantations and estate farms. Up to the time of independence in 1961, food crop research was virtually non-existent in Tanzania. This means that research programmes were not designed to support topics which the farmers themselves considered to be of interest. Research programmes were imposed from the top, with no real mechanism for the identification of local desires and difficulties and for these to be reflected in the research planning process.

Only a handful of agricultural research institutes existed during the colonial period. The number increased after independence. Just before the formulation of the National Agricultural Research Masterplan there were altogether about 55 research institutes, stations and sub-stations. For some time most of these research institutions have been characterized by too little government funding. The research staff were demoralized by the impossible working conditions, with no means of doing research, minimal research facilities and no means of transport. Government set no research priorities or research strategies. In the absence of these, some donors willing to assist in agricultural development and related research have come forward and formulated their own priorities or have relied on the judgement of local interest groups. Agricultural research was also severely affected by the collapse of the East African Community. In the late 1970s and early 1980s agricultural production stagnated or declined in response to all these factors and to internal and external events associated with the country's economy.

Some of the agricultural training institutes are located on the same site as research institutes or stations. These training institutes were subjected to similar conditions. They experienced inadequate funding, lack of teaching facilities, lack of transport, and shortage of adequately trained staff. These conditions impaired the quality of training of the agricultural extension workers to some extent. Technical subject knowledge about agriculture is the chief commodity that the extension worker has to offer farmers. There is no substitute for sound technical training. The extension worker must have a thorough knowledge of technical information appropriate to his or her work and must keep abreast of relevant current material.

CONTRIBUTION OF AGRICULTURAL RESEARCH TO AGRICULTURAL DEVELOPMENT

Agricultural development is a function of a multiplicity of factors. Social, economic, technological and political factors all have a strong influence on agricultural development. Needless to say, agricultural research is one of the essential elements required if agriculture is to develop and hence contribute to the social and economic development of Tanzania. It is true that some deficiencies exist in agricultural research. They have been diagnosed and analyzed, and relate to the identification and establishment of priorities, to institutional and management arrangements, to funding, and to the provision of sufficient well-trained scientists and technicians. Even so, agricultural research has made significant contributions to agricultural development in various fields.

Agricultural research has played an important role in the generation and adoption of technologies to increase agricultural productivity; in developing sustainable production systems for various agro-ecological zones; in generating technologies which can provide productive employment and a greater return to labour in the rural areas; and in contributing to both national and household food security.

Crop research

It is worth noting that whereas before independence cash crop research was emphasized, research stations established since independence, such as Uyole Agricultural Centre and the new programmes at Ilonga, have placed great emphasis on food crop production. In fact, even the stations formerly devoted to cash crops have expanded their activities to include other programmes. A good example is that of Mlingano Sisal Research Station, where the National Soils and Fertilizers Research Programme was established as one of the new programmes. This was an important step in the right direction, helping to correct pre-independence anomalies and making a great contribution to agricultural development.

Before the initiation of the National Agricultural Research Programme, there existed about 23 crop research programmes. Research on crops and related programmes were well co-ordinated by individual commodity research committees, and the coordinator for each crop was based at the institute or centre with the lead responsibility for that crop. These committees have been valuable in eliminating unnecessary duplication of research effort within the institutions, contributing a great deal to overall agricultural development.

Crop research priorities include cereals, legumes, root and tuber crops, oil seeds, banana and plantain, industrial crops, horticultural crops and spices. Other research priorities include soils, crop protection, farming systems research, agroforestry, viticulture and resource efficient farming methods. Prioritization of agricultural research is another step towards agricultural development.

Cereal research programmes. The agricultural research programmes have developed some high yielding hybrids and varieties. For instance, in the maize research programme, from 1982 until the present, about 10 good maize cultivars, capable of producing 2.3-3.5 t ha^{-1}, have so far been developed. The maize cultivars released include Kito, Staha, Kilima, TMV I and TMV II.

There have also been a number of achievements in the rice research programme. From hybridization work, varieties such as Selemwa and IET2397 (Katrin), have been released. So far, about 10 varieties have been developed, yielding 4-5 t ha^{-1}. An agronomic package including time of

planting, spacing, seed rates and fertilizer rates has been developed. Hybridization work involving a series of crosses between local and introduced varieties is producing successful results (TARO, 1988a).

A strong research programme on wheat was initiated in the early 1970s in order to develop, release and promote the use of superior small grain cultivars (bread wheat, durum, triticale and barley). A further aim was to develop an agronomic package incorporating appropriate cultural methods, including weed control, cultivation, harvesting techniques, crop rotation and mechanization. About 11 new varieties were released, with yields between 2.8 and 3.4 t ha^{-1}, including Viri, Tembo, Duma, Azimio 87, Selian 87, Mbayuwayu, Tausi, Juhudi No.I and Juhudi No.II, Njombe 6 and Njombe 7, and Tanwat 87.

A hybridization programme for sorghum and millets was established with the aim of developing varieties and hybrids with good grain characteristics, wide adaptation, acceptable maturity duration and the capacity to produce stable grain yields. Varieties that have been released so far include Tegemeo, Sandala, Mbangala, Lulu and Serena. Some of the cultivars developed can yield 2.3-3.5 t\ha^{-1}.

Legumes research programme. Before 1974 only limited legume variety improvement and agronomy work was conducted, at a limited number of locations. Thereafter, the number of locations was increased. The objectives of the legume research programme were to develop high yielding varieties resistant to the most important diseases and, to some extent, insect pests, and also to identify and develop improved forms of management that are practical and economical for grain legume production. Several varieties of cowpea have been released, including Tumain and Fahari, which yield from 1800 to 2200 kg ha^{-1}. In the green gram research programme one variety has been released: Imara, which yields from 1500 to 1800 kg ha^{-1}. A package of agronomic recommendations for green gram and cowpea production has been developed, which includes plant populations, time of planting, insecticide spray schedules and intercropping recommendations. The bean research programme has resulted in the release of several varieties, including Canadian Wonder, Kabanima, Lyamungu 85, Uyole 85, Masai Red, SUA 90, Uyole 90, Lyamungu 90 and Ilomba (TARO, 1988b).

Root and tuber research programme. The main objectives of the root and tuber research programme are to develop improved varieties and agronomic packages, and control measures against economically important pests and diseases, for use by smallholder farmers to increase the production of cassava and sweet potatoes. A number of cassava varieties have been developed by the root and tuber research programme. They include Liongo-C, Ali Mtumba, Mapangano, Kibaha and Likumbukwa. The sweet potato research programme has developed an improved sweet potato variety called SPN/O. In the case of Irish potatoes *(Solanum tuberosum)* varieties released include Subira, Kikondo, Bulongwa and Tana (TARO, 1988c).

Oil seed research programme. One of the objectives of the oil seed research programme was to identify and develop varieties of sesame, groundnuts and sunflower adapted to the main growing areas of Tanzania, with good yield potential, good resistance to diseases, and desirable agronomic characteristics. Two varieties of sesame, Bora and SSBS7, have been released. In the case of the groundnuts research programme, two varieties, Nyota and Johari, have been recommended to farmers. The improved sunflower varieties recommended were Record and Jupiter (TARO, 1988d).

Industrial crops research programme. One of the broad objectives of the sugarcane research programmes is to provide the sugar industry with superior, high yielding, adaptable clones, resistant to the prevailing diseases and insect pests. The programme has released two sugarcane varieties, TZ76 and T79. The cotton research programme has released 17 new varieties, including UK82 and IL85.

The cashewnut research programme has released the varieties AC4, AC10, AZA17 and AZA2. The coffee research programme released N39, KP423 and H66, and has also developed methods to control coffee berry disease. The tobacco research programme has released three varieties, PD4 Coker, NC89 and KS1E.

The annual production of food crops is shown in Table 1 and that of industrial crops in Table 2. Overall, there has been an annual increase in crop production over the period shown (TARO, 1988e).

Table 1. Production of major food crops, 1967-1985 (t x 10^3)

	Maize	Paddy	Wheat	Cassava	Sorghum/ finger millet	Legumes	Irish potato	Sweet potato	Bananas
1967/68	750	114	43	990	344	174	35	254	891
1968/69	770	131	40	1 080	374	172	46	253	140
1969/70	730	144	41	1 050	372	159	62	238	185
1970/71	870	192	60	1 033	413	180	74	248	261
1971/72	850	202	77	963	367	183	67	229	998
1972/73	980	178	67	957	409	224	120	234	1 206
1973/74	750	193	49	1 016	423	193	165	296	1 400
1974/75	750	141	32	1 106	280	182	101	302	1 400
1975/76	825	157	46	1 146	440	181	87	320	1 500
1976/77	897	180	58	2 270	390	210	92	330	1 500
1977/78	968	203	35	1 200	390	219	96	335	1 580
1978/79	1 000	260	38	1 335	410	212	85	330	1 466
1979/80	900	250	30	1 365	380	213	85	330	1 495
1980/81	800	180	27	1 380	169	219	84	332	1 300
1981/82	1 782	415	95	1 658	970	207	89	320	1 310
1982/83	2 116	339	84	1 575	1 150	303	92	315	1 220
1983/84	2 441	597	73	1 934	766	294	126	309	1 160
1984/85	2 405	458	14	1 918	843	323	139	340	1 276

Source: Ministry of Agriculture and Livestock Development.

Table 2. Production of major industrial crops, 1966-1986 (t x 10^3)

	Coffee	Cotton	Tobacco	Tea	Cashewnut	Sisal	Pyrethrum
1966/67	44 613	231 713	5 747	7 157	84 050	225 074	5 971
1967/68	46 226	NA	7 244	7 923	73 828	220 084	5 184
1968/69	52 663	150 963	8 778	8 778	196 884	196 884	4 834
1969/70	44 586	204 045	11 044	8 492	110 344	209 303	2 416
1970/71	47 005	223 835	11 971	9 182	112 302	202 180	2 667
1971/72	52 209	193 465	14 167	11 613	126 026	181 104	3 655
1972/73	47 517	225 709	17 330	13 291	125 523	156 849	4 016
1973/74	42 445	188 417	13 910	12 258	145 080	155 400	3 282
1974/75	52 082	206 490	18 209	13 872	118 947	143 400	4 643
1975/76	55 359	122 928	14 198	13 049	83 734	127 840	4 185
1976/77	48 681	194 012	18 775	15 221	97 652	119 077	3 365
1977/78	51 889	150 475	18 320	18 462	68 383	105 108	2 870
1978/79	49 633	167 530	17 067	17 633	57 068	91 873	1 580
1979/80	47 993	177 755	17 023	17 312	41 519	81 384	1 621
1980/81	67 695	170 100	16 615	16 335	56 558	85 978	2 002
1981/82	55 532	131 150	16 191	15 595	44 309	73 153	1 899
1982/83	53 922	130 423	13 564	17 551	32 556	60 645	1 602
1983/84	61 250	141 070	12 312	11 940	47 960	40 240	1 905
1984/85	49 120	154 848	13 434	16 677	32 073	37 470	1 600
1985/86	NA	216 000	13 232	15 448	20 000	NA	NA

NA, not available.
Source: Ministry of Agriculture and Livestock Development

Resource efficient farming methods and agroforestry research programme. The major objective of the programme is to conduct research into ways of providing alternatives, or supplements, to the inadequate, often unavailable, and costly commercial agricultural inputs, to increase or maintain agricultural production. Research has been done on the application of farmyard manure and compost, application of Minjingu rock phosphate, triple superphosphate and sulphate of ammonia fertilizers, alley cropping, and intercropping (TARO, 1988f).

Livestock research

The first livestock research in the country was done by the Germans at Mpwapwa in 1905. In the 1920s and 1930s great emphasis was placed on controlling animal diseases when exotic cattle were imported for crossing with local breeds. This was the beginning of genetic improvement by cross breeding and selection, an important step in livestock development. Later it was found that genetic improvement by cross breeding and selection was less important than improved management in achieving increased productivity. Research on various types of livestock management was then initiated.

Recently it has been realized that animal nutrition is equally as important as, if not more important than, disease control and genetics. Currently, great emphasis is being placed on pasture and forage research. Methods of controlling diseases such as rinderpest, and east coast fever, brucellosis, and foot and mouth disease have been developed.

About 20,000 doses of blackquarter vaccine have been produced. In the field of animal nutrition, livestock feeds for increased production have been formulated. Several improved zebu breeds have been developed and are available for cross-breeding purposes, for example the Boran, Brahman, Mpwapwa and Sahiwal. These are superior to other local zebu breeds in terms of their size and milk production.

The problems of tsetse and trypanosomiasis are major limiting factors in the development of the agricultural and livestock sectors in Tanzania. Although there is no long-term national tsetse and trypanosomiasis eradication plan, much research work has been done on tsetse and trypanosomiasis control.

A total of 801 livestock research reports and papers have been produced between 1824 and 1982. A breakdown of the topics studied or researched is shown in Table 3.

Cattle research programme. There are four livestock research stations in Tanzania. Some deal specifically with cattle development and others also deal with small ruminant development. In addition, some research on cattle production is carried out at Uyole Agricultural Centre and at Sokoine University of Agriculture. Research activities deal with the development of a dual-purpose composite breed of cattle, crossbreeding for milk production, and selective improvement of Boran and Tanzania shorthorn zebu cattle. The cattle research programme has developed a Boran breed which is more productive than the small African shorthorn zebu. Another research achievement is the development of the dual purpose Mpwapwa breed. Breeding and selection work on the Tanzania shorthorn zebu has had the objective of increasing milk production. This has been achieved by research on the management (feeding) of purebred exotic cattle and by cross-breeding. Much research work has also been done on selection for beef production, based on the Tanzania shorthorn zebu, with the aim of improving reproductive efficiency, mothering ability, growth rate, post-weaning growth, survival rates and carcass characteristics, with some success.

Small ruminant research programme. Small ruminant research, with the aim of increasing meat and milk production, has been going on for some time. The emphasis has been on breeding. Over the last 23 years, small ruminant research has been accorded some importance by the Tanzania Livestock Research Organization (TALIRO) and additional research has been done on such topics as the evaluation and selective improvement of the indigenous stock and the evaluation of various management practices.

Table 3. Papers and reports produced on livestock research by topic, as a percentage of the total

	Pre-1960	1961-1970	1971-1980	1981+
Tsetse				
Epidemiology/ecology	20	7	5	7
Chemical control	30	18	6	6
Other control methods	6	8	3	13
Trypanosomes				
Epidemiology/ecology	-	-	1	7
Transmission/infection	6	13	7	4
Treatments	-	1	2	5
Tolerant cattle	-	2	1	1
Schistosomes				
Diaorrhea/epidemiological/treatment	1	1	0.5	2
Molluscan host/biological control	-	-	1	2
Chemical control	4	3	1	-
Fascioliasis	-	-	2	1
Yersina pestis (plague)	4	4	3	3
Ticks				
Vectors	4	4	3	3
Chemical control	-	3	6	6
Resistance	-	1	1	1
Mites and fleas	-	1	1	1
Theilaria (mainly treatment of *T. parva*)	3	17	13	4
Filariasis	1	-	3	1
Vectors	-	2	8	3
Leishmaniasis	-	-	0.5	2
Insecticides	2	-	0.5	-
Vector-borne diseases	-	-	2	1
Biting flies	-	1	2	0.5
Brucellosis	-	3	2	1
Minor viral and bacterial infections	1	2	3	3
Helminth parasites	-	1	4	1
Rinderpest	4	2	-	5
Mycoplasma	7	1	-	-
Animal health, general	9	1	2	6
Veterinary (anaplasma, faciola, theileria, rinderpest, contagious tick-borne, pleuropneumonia)	11	-	7	4

Source: Smith (1990).

The main objective in meat goat breeding has been to increase the productivity of crossbred goats by improvements in weight for age, growth rate, fecundity, carcass quantity and quality, and resistance to disease, with good results. The dairy goat breeding programme has had the aim of increasing milk production, weight for age and productive traits. The programme has been successful.

The main objective of sheep breeding research has been to improve weight for age, carcass fat yield, and fecundity. Again, good results have been obtained.

Breeding stocks of small ruminants have been sold or issued to farmers and other institutions to improve their flocks. Improved breeds of goats and sheep from the research centres have had a substantial impact on livestock production, especially in the districts and regions surrounding the research centres and institutes.

Encouraging results have been obtained as a result of research on various managerial aspects such as feeding regimes, housing, castration, and age of weaning.

AGRICULTURAL TRAINING

Agricultural research alone cannot solve all the problems related to agricultural development. Agricultural development is dependent, among other things, on the ability of the country to produce an adequate staff of properly trained professionals to do research, and conduct formal and informal agricultural education. The formal education system produces the middle and high level staff required for research, training, policy making and planning technical services, such as extension, plant protection, land use planning, crop processing and storage, irrigation and mechanization. Extension education falls into the category of informal education.

The contribution of agricultural training and education to agricultural development in Tanzania can be assessed by observing the steady increase in trained people since 1961/62 (Table 4). The deployment of certificate holders to regions is shown in Table 5 and that of diploma holders in Table 6.

In order to enhance agricultural education at the grassroots level, several farmer training centres were established in the early years of independence. These centres were aimed at training farmers in various disciplines of agriculture, according to the locality. Farmer training centres performed very well up to 1972, when they were transferred to the Prime Minister's Office and subsequently to the Ministry of Education.

After independence, agriculture as a subject was introduced into the primary and secondary school systems with the aim of encouraging students to have a positive attitude towards farming, and of enabling them to engage in agricultural production as a source of income for those who did not continue with schooling.

FUTURE PROSPECTS

Much has been achieved in agricultural development, partly as a result of intensified research and training programmes. Even so, this is not an excuse for complacency. A great challenge lies ahead of us because of the rapid pace of technological change taking place in the agricultural industry. To cope with these changes there will need to be even greater concerted research and training efforts. Much has already been spelled out in the National Agricultural Research Masterplan. Additional considerations are mentioned here.

There is a need to incorporate concerns about 'sustainability' into research strategies. Sustainability here means the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources (Reardon and Nurul, 1989). This entails consideration of such questions as: Will the farmers want to invest in the productivity and sustainability innovations proposed by agricultural researchers? How should these innovations be designed to maximize the likelihood of adoption? What production systems should researchers be advocating to farmers? What are the environmental consequences of the systems and of farmers' choices? Research institutions should integrate the farmers' perspective into the design and evaluation of productivity and sustainability innovations.

There is a need to increase efforts to incorporate farmers' views more fully into the research process. Farrington (1989) observed that where farmers are spatially remote from decision-making centres, and where communications are poor and the level of literacy is low, farmers are less likely to exert a 'demand-pull' on the research agenda unless researchers make a deliberate attempt to elicit their views and to observe in the field how and why farmers accept or reject new technologies. Hence the need for farmer participatory research.

A high priority should be given to research aimed at planning, designing, testing and monitoring the adoption and environmental consequences of new technologies and identifying constraints to their sustainability.

Table 4. Total number of agricultural workers who completed their training from agricultural and livestock training institutions, between 1961/62 and 1990/91

Type of course taken	61/62-84/85	85/86	86/87	87/88	88/89	89/90	90/91	Total
Certificate								
Agriculture	7 134	367	373	332	399	394	326	9 325
Animal Health and Production	1 995	177	172	148	206	184	178	3 060
Tsetse Control	19	15	16	14	15	14	7	100
Laboratory Technology	82	-	12	-	17	-	15	126
Total	9 230	559	573	494	637	592	526	12 611[1]
Diploma								
Agriculture	703	-	-	-	-	-	-	703
Food Science and Nutrition	121	-	-	-	-	-	-	121
Crop Production	1 157	105	108	108	98	89	83	1 748
Farm Management	268	18	21	19	24	26	26	402
Horticulture	187	26	28	23	27	30	26	347
Agromechanization	443	41	45	54	39	41	46	709
Agric. Home Economics	140	-	-	-	-	-	-	140
Irrigation	306	21	21	19	24	21	16	428
Land Use Planning	34	24	17	19	13	21	13	141
Food Production and Nutrition	-	-	-	43	37	49	42	171
Dairy Husbandry	228	33	32	26	35	31	23	408
Animal Production	513	56	57	51	59	55	40	831
Animal Health	367	44	42	46	48	52	23	622
Range Management	185	-	26	-	7	27	-	245
Poultry Production	34	18	16	20	10	18	16	132
Meat Inspection	15	14	12	15	13	15	12	96
Tsetse Control	55	-	18	-	17	-	11	101
Laboratory Technology	34	19	-	16	-	-	-	69
Total	4 790	419	443	459	451	475	377	7 414
BSc (local)								
Food Science and Nutrition	-	-	-	-	-	10	12	22
Home Economics and Human Nutrition	-	-	-	-	11	13	3	27
Agric. Enginering	-	-	-	-	15	18	17	50
Agriculture	901	90	77	97	49	98	47	1 125
Animal Science	-	-	-	-	-	-	15	15
BVM/BVSc (local)	69	17	18	13	17	12	14	146
Local sub-total	970	107	95	110	92	151	108	1 363
BSc Agriculture (overseas)	175	-	3	2	6	-	-	186
BVM/BVSc (overseas)	52	-	1	-	1	-	-	54
Overseas sub-total	227	-	4	2	7	-	-	240
Degree total	1 197	107	99	112	99	151	108	1 603

[1]About 60% of the total with certificate-level training have been upgraded to diploma level under the In-Service Training Programme. The actual number who remain at certificate level is therefore about 5070.
Source: Ministry of Agriculture and Livestock Development.

Table 5. Deployment of qualified agricultural staff: certificate holders 1986-1989

Region	Agriculture				Livestock				Total
	1986	1987	1988	1989	1986	1987	1988	1989	
Arusha	14	33	18	17	9	8	3	11	113
Dar es Salaam	-	3	2	-	-	3	5	4	17
Dodoma	15	12	13	16	9	7	9	11	92
Iringa	20	29	27	13	9	5	6	13	123
Kagera	15	31	17	22	12	4	5	13	119
Kigoma	16	2	15	17	9	6	2	8	75
Kilimanjaro	9	12	10	10	10	5	1	10	67
Lindi	18	8	8	18	15	3	5	8	83
Mara	20	8	18	15	10	7	2	7	87
Mbeya	21	42	22	22	8	11	18	17	151
Morogoro	22	43	29	13	7	16	9	9	148
Mtwara	21	2	8	23	10	1	3	14	82
Mwansa	18	23	15	30	10	13	7	15	131
Coast region	16	15	18	20	11	3	6	13	102
Rukwa	17	13	16	21	12	4	12	14	109
Ruvuma	21	12	22	15	4	4	4	5	85
Singida	23	2	13	13	8	11	8	10	88
Shinyanga	19	8	15	18	14	12	19	13	118
Tabora	21	8	13	17	7	6	9	9	90
Tanga	15	15	16	14	12	11	10	10	103
Ukulima va Kisasa	-	-	-	-	-	-	-	-	-
Total	341	321	315	334	186	140	183	214	2 034

Source: Ministry of Agriculture and Livestock Development, Research and Training Division.

Integrated research is necessary to back up the planning, design, implementation and monitoring of development programmes and minimize competition among sectors (agriculture, forestry, fisheries, mining and industry) in the utilization of natural resources.

Socio-economic research should be emphasized, as until now biological research has been dominant in most agricultural research institutions. There is an urgent need for balancing biological and socio-economic research. Socio-economic research should include studies of household dynamics with respect to decision making, gender issues, resource management, labour inputs and the sharing of returns and outputs by different members of the household.

There should be periodic reviews and a sharpening of the focus on research priorities. It will be unwise to have programmes where too few resources are spread over too many research activities. It will be equally unwise to take too long to re-visit and review research priorities because these will change with changing social, economic, technological and political circumstances.

In addition to the current agricultural training programmes, particularly at university level, it is recommended that a high priority should be given to research management training for research fellows in MSc and PhD degree-related research programmes.

Periodic review of training programmes and curricula is necessary in order that they keep abreast of technological changes taking place in the agricultural industry.

There is a great need for the formation of multidisciplinary research teams and training in this approach to research, and an improvement in the management of existing multidisciplinary teams.

Table 6. Deployment of qualified agricultural staff: diploma holders 1986-1989

Region	Agriculture				Livestock				Total
	1986	1987	1988	1989	1986	1987	1988	1989	
Arusha	8	12	22	10	7	11	10	8	88
Dar es Salaam	1	-	1	3	3	3	-	4	15
Dodoma	6	3	13	7	6	7	11	7	60
Iringa	10	6	12	18	8	2	8	7	71
Kagera	5	2	5	8	7	3	4	8	42
Kigoma	8	2	11	12	6	4	6	6	55
Kilimanjaro	14	9	11	9	10	4	5	11	73
Lindi	8	2	11	8	10	3	5	3	50
Mara	6	4	9	5	3	4	11	10	52
Mbeya	8	18	14	9	8	7	13	11	88
Morogoro		14	17	10	5	8	5	8	73
Mtwara	10	3	5	7	5	1	4	6	41
Mwansa	10	11	10	13	5	6	11	12	78
Coast region	9	6	14	14	5	6	9	8	71
Rukwa	6	3	5	11	10	7	8	5	55
Ruvuma	9	4	8	10	4	6	5	4	50
Singida	5	1	16	5	4	6	9	7	53
Shinyanga	7	4	8	19	6	7	7	4	62
Tabora	8	6	7	10	4	9	10	13	67
Tanga	12	10	14	9	10	10	17	11	93
Ukulima va Kisasa	-	-	2	-	-	-	1	2	6
Total	156	121	215	197	126	114	159	155	1243

Source: Ministry of Agriculture and Livestock Development, Research and Training Division.

Research collaboration among disciplines, individuals and institutions is necessary, but collaboration is like marriage, easily contracted but only successful if continuous effort and compromise are devoted to making it work.

Most research and training institutions in Tanzania remain isolated from global information networks. Much new knowledge and many new technologies are being developed in other places and remain unknown to interested individuals. There is a need to make this information available to training and research institutions.

More emphasis should be placed on developing a stronger more effective collaborative mechanism to link faculties of agriculture with agricultural research and training institutes, and with the Ministry of Agriculture, Livestock Development and Cooperatives.

CONCLUSION

Tanzania has been relying heavily on an expansion in the area under cultivation for achieving annual increases in agricultural productivity. Consequently, with rapid human and livestock population growth and also the movement into villages (the 'villagization' programme), in some parts of the country pressures on the land have increased and periods of fallow have been shortened to the extent that they are insufficient to allow a recovery in soil fertility for subsequent cropping cycles. Traditional farming systems are no longer capable of satisfying the escalating demand for food, animal

feed, fibre and other products, including foreign exchange and capital for development and the purchase of inputs. This calls for a change in strategy, involving the use of new or modified technologies to increase agricultural productivity. This can be achieved by increased cropping intensity, by increased yield per unit of labour and land.

We therefore need research and training strategies and technologies which include the genetic improvement of crops and animals, mechanization and other appropriate technologies, integrated pest, disease and weed management, and improvements in and a broadening of the range of post-harvest technologies. All these depend on the efficient operation of research and training institutions. If these institutions are to continue to play a leading role in agricultural development, and hence in the social and economic development of the country, government funding must be increased to meet current and development expenditure, research policies must be formulated and followed, an adequate number of competent researchers and trainers must be maintained, and adequate research facilities (including transportation) must be provided. Remuneration and housing also need improvement.

It is worth remembering that agricultural development across a wide spectrum is fundamental to the development of Tanzania's economy. Agricultural development in turn depends on the adoption of appropriate technology. Both research and training are vital for the development of agriculture and livestock as a whole.

REFERENCES

Farrington, J. (1989). Farmer participatory rsearch; prospects for Africa. In Proceedings of the Symposium of Agricultural Production systems in Sub-Saharan Africa, Aas, Norway, 1989.

Reardon, T. and Nurul, I. (1989). Issues of sustainability in agricultural research in Africa. In Proceedings of the Symposium of Agricultural Producton Systems in Sub-Saharan Africa, Aas, Norway, 1989.

Smith, P.D. (1990). *An Evaluation of Past Agricultural Studies in Tanzania.* Bangor, Wales: Centre for Arid Zone Studies, University College.

TARO (1988a). Cereal Crops Research Highlights 1982-1987. Dar es Salaam: Tanzania Agricultural Research Organization (TARO).

TARO (1988b). Grain Legumes Research Highlights 1982-1986. Dar es Salaam: Tanzania Agricultural Research Organization.

TARO (1988c). Root Tuber Crops Research Highlights 1982-1986. Dar es Salaam: Tanzania Agricultural Research Organization.

TARO (1988d). Oilseeds Research Highlights 1982-1987. Dar es Salaam: Tanzania Agricultural Research Organization.

TARO (1988e). Industrial Crops Research Highlights 1982-1987. Dar es Salaam: Tanzania Agricultural Research Organization.

TARO (1988f). Resource Efficient Farming Methods and Agro-forestry Research Highlights 1983-1987. Dar es Salaam: Tanzania Agricultural Research Organization.