Report to the Government of
The Democratic Republic of Somalia

Development of an Agricultural Research System

isnar

International Service for National Agricultural Research

The International Service for National Agricultural Research (ISNAR) began operating at its headquarters in The Hague, Netherlands on September 1, 1980. It was established by the Consultative Group on International Agricultural Research (CGIAR), on the basis of recommendations from an international task force, for the purpose of assisting governments of developing countries to strengthen their agricultural research. It is a non-profit autonomous agency, international in character, and non-political in management, staffing and operations.

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

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LIST OF ACRONYMS

ADC	Agricultural Development Corporation
ARI	Agricultural Research Institute
AVRDC	Asian Vegetable Research and Development Center, Taiwan
BRDP	Bay Region Development Project (BRDP)
CARS	Central Agricultural Research Station
CIDA	Canadian International Development Agency
CIMMYT	The International Maize and Wheat Improvement Center, Mexico
CRDP	Central Rangelands Development Project
DAH	Department of Animal Health
DAP	Department of Animal Production
FA	Faculty of Agriculture, Somalia National University
FAO	Food and Agriculture Organization of the United Nations
FVMAP	Faculty of Veterinary Medicine and Animal Production, Somalia National University
GADP	Gross Agricultural Domestic Product
GDP	Gross Domestic Product
ICIPE	International Centre for Insect Physiology and Ecology, Kenya
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, India
IDRC	International Development Research Centre, Canada
IFPRI	International Food Policy Research Institute, United States
IITA	International Institute of Tropical Agriculture, Nigeria
ILCA	International Livestock Centre for Africa, Ethiopia
ILRAD	International Laboratory for Research on Animal Diseases, Kenya
ISNAR	International Service for National Agricultural Research, Netherlands
MLFR	Ministry of Livestock, Forestry and Range
MLSA	Ministry of Labor and Social Affairs
MNP	Ministry of National Planning
MOA	Ministry of Agriculture
MUCIA	Mid-Western Universities Consortium for International Agriculture
NBB	National Banana Board
NRA	National Range Agency
NRDP	Northern Rangelands Development Project
OAU/SAFGRAD	Organization for African Unity/Semi-Arid Food Grain Research and Development
ONAT	Farm Machinery and Agricultural Services Organization
SMY	Scientist Man-year
SVI	Serum and Vaccine Institute
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development

Sh15 = US$1 at current official exchange rates. Various exchange rates are used in planning figures.

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CHAPTER ONE : Introduction

An exchange of messages between the Ministry of Agriculture, Somali Democratic Republic, and the International Service for National Agricultural Research (ISNAR), facilitated by the Office of Agriculture of the United States Agency for International Development, Mogadishu, led to a visit to Somalia in January 1983 by ISNAR staff members Drs. Mijumbi Nyiira and Floyd Williams. Their discussions with officers in the Ministry of Agriculture, the Ministry of Livestock, Forestry and Range, the Ministry of Higher Education, and with development assistance personnel, identified two major tasks that, if accomplished, would facilitate the development of Somalia's agricultural research system.

The first task was to develop a strategy statement to guide the development of the agricultural research system. The second task was to define a series of priority research activities, including associated achievable objectives, methodologies, and resources needed. It was agreed that ISNAR would help Somalia develop the strategy statement and that Somali personnel, assisted by others knowledgeable about agriculture in Somalia, would undertake the second task.

Major issues that seemed to demand attention in the strategy statement included:

1. The expectations of the government from its research system, the form the system should take, and the level of resources it should have;

2. The mechanisms needed to develop the manpower required to do the research, and the characteristics of a career structure to retain productive research personnel in the system;

3. The mechanisms to achieve the needed integration of research activities in separate ministries;

4. The mechanisms to integrate research with postgraduate education in major agricultural subjects, and effectively to incorporate relevant university staff into the research system.

These issues were discussed with government officials during the January visit and later affirmed in an exchange of correspondence between the Director General of ISNAR and the Minister of Agriculture. It was agreed that ISNAR would supply a small team to help develop the research strategy. The team, consisting of Drs. Matthew Dagg, Mijumbi Nyiira, William Pritchard, and Floyd Williams (leader) arrived in Mogadishu on May 3, 1983. (biographical sketches of team members are given in Annex 1.) The team received excellent cooperation and assistance from government officers and development assistance personnel. Mr. Abdullai Nur Alio, Director, Agriculture Research Institute; Mr. Mohamud Haji Ibrahim, Assistant Director of Planning, Ministry of Livestock; and Dr. J.S. Bakshi, Project Manager, UNDP/FAO, who traveled with the team much of the time, were especially helpful.

The team met with individuals and small groups of researchers, administrators, and development assistance personnel during their first three days in Mogadishu. They traveled by road to Baidoa, Jilib, and Kismayo, where they visited research stations, extension training sites, a veterinary diagnostic laboratory, and other agricultural facilities. Several days were filled with visits to various ministries, agricultural service units, and offices in the Mogadishu-Afgoi area, including the Somalia National University Faculty of Agriculture and Faculty of Veterinary Medicine and Animal Production Serum and Vaccine Institute, National Range Agency, National Academy of Science and Arts, and development assistance agencies. (A partial list of persons contacted is in Annex 2.) A trip by air to the Hargeisa area had to be forgone when the airline schedule was disrupted. In all instances the team was accorded cordial hospitality and full cooperation.

The team presented highlights of its findings to Dr. Mohamed Ali Nur, Minister of Livestock, Forestry and Range, Dr. Mohamed Abdi Nur, Vice-Minister of Agriculture, and a few key ministry officers on May 22 and received their comments and suggestions.

This report sets forth the main findings of the team. It notes the major features of Somali agriculture as they relate to research[1] (Chapter 2), and describes the role that agricultural research should have in Somalia (Chapter 3). It then briefly describes the current agricultural research system, with emphasis on elements that require attention (Chapter 4). These elements are developed as the main issues (Chapter 5), then conclusions and recommendations are summarized (Chapter 6).

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[1]Detailed background information on Somalia is available in: World Bank. 1981. Somalia Agricultural Sector Review. Eastern Africa Regional Office, Nairobi; and Kaplan, Irving, et al. 1977. Area Handbook for Somalia. Washington, D.C. American University.

CHAPTER TWO : Agriculture in Somalia in Relation to Agricultural Research

Agriculture, which in this report refers to the production, processing, and marketing of livestock and crops and the use of range, soil, and irrigation water, is by far the most important industry in Somalia. About 80% of the country is too dry for reliable cropping and is used for rangeland. Complex livestock herds harvest the primary product from the rangeland and convert it into milk, meat, and other products. The range thus supplies sustenance and employment to some 3 million persons (60% of the people) and 70% to 90% of the foreign exchange earned. (See Annex 3 for imports and exports.) Rangelands also contribute a substantial part of the livelihood of the 1.2 million settled rural people who cultivate crops and who also keep livestock that utilize the communal range for part of the year. Most of the meat consumed by the 0.8 million urban dwellers is produced by the rangelands, and some urban people are employed in livestock-related services (Central Statistical Department 1979).

Many authorities (World Bank 1981b) believe that the rangeland animal population has reached or exceeded the numbers that can be supported under present management practices without damaging the basic land resource. The climatic environment is harsh, and the water balance for vegetation dominates prospects for production of both rangelands and rainfed crops. In most of the rangeland, annual rainfall averages from well under 200 mm to 400 mm, fluctuating widely among years and locations. Potential evapotranspiration from a full vegetative cover is about 200 mm per month, so active growth of range vegetation is limited to two or three months per year, depending upon the degree of ground cover and infiltration. Management can have some influence on the composition of the range vegetation, but it probably cannot increase total primary production to any great extent in this low rainfall-high evapotranspiration zone. Management of livestock and their water supply can, however, influence considerably how much of the primary vegetative production is converted into useful products.

As the human population continues to grow at 3% per annum, more attention is being given to increasing food production from crop cultivation. Crop production now supplies a large part of the livelihood for 0.85 million Somalis. Crop statistics are not reliable, but they present the following information: Sorghum is the main rainfed crop. Mungbeans and cowpeas are thought to be important rainfed crops, and groundnuts may become so. Some maize is grown as a rainfed crop; it is the main food crop on areas that receive controlled irrigation (60,000 ha) or supplementary flood irrigation (110,000 ha). The only major export crop, banana, is grown under controlled irrigation and supplies about 10% of earned foreign exchange. Other important irrigated crops are sugarcane, cotton, and sesame.

Further development of irrigation is expected to increase both food and cash crop production and provide employment for settling displaced pastoralists. The World Bank review indicates that some 160,000 ha of irrigated land could be developed along the Juba river, which would bring the total under controlled irrigation to about 220,000 ha. The current low productivity of the water and land under controlled irrigation allows substantial scope for improvement, while the flood-irrigated lands offer less but noteworthy potential.

Reliable information on area planted to dryland crops each year is unavailable. From the limited information available, it seems that a substantial part of the cropped area may not be planted in any given year, being left in a weedy fallow. If so, this provides some forage for livestock, which would decrease as the dryland crop area increases. Estimates of potential new area worth cultivating vary wildly because of inadequate rainfall and climatic data, but a recent unpublished survey of the important inter-riverine zone suggests that only a further 88,000 ha or so may be available. This finding will have serious implications for the potential of this area to absorb surplus population from the rangelands; it highlights the extreme importance of using irrigation water with the greatest possible efficiency, in terms of yield per unit of available water.

Improving the productivity of the rainfed croplands will be difficult. Rainfed crop production is attempted in areas where the average annual rainfall is above 400 mm. Most of the country receives rain in two seasons, so even in these higher rainfall areas, the average rainfall available for a crop season is seldom more than 300 mm. In most seasons water stress reduces crop yields.

The harsh climatic environment, resulting from low and erratic rainfall coupled with high evapotranspiration rates, places formidable obstacles against efforts to increase the vegetative productivity of rangelands. Unless many Somalis can become coastal fishermen, much of the future increase in population will have to derive their livelihood from increased offtake from the rangelands and from increased productivity of the irrigated and rainfed croplands. Both will require enlightened policies, development and use of better production techniques, and more efficient marketing, all products of an effective agricultural research system.

2.1 Livestock Production and Marketing

2.1.1 Production Systems

The Somali livestock herd is estimated (Central Statistical Department 1979) as 5 million camels, 4 million cattle, and 25 million sheep and goats -- for a total of 10.3 million tropical animal units. Mixtures of browsing (camels and goats) and grazing (cattle and sheep) species ensure maximum utilization of edible plants in the brushy rangelands typical of Somalia. Three traditional production systems prevail: (1) nomadic pastoralism, (2) mixed crop and livestock farming systems, and (3) urban confinement systems. In addition, the Ministry of Livestock, Forestry and Range (MLFR) operates a number of ranches, dairies, and poultry production units.

Nomadic pastoralism is the way of life of some 60% of the people. They obtain most of their subsistence from their herds and flocks, producing some products for sale. Nomadic pastoralism is probably the most economic way to utilize rangelands of low productivity when labor is abundant and capital scarce. Seasonal migration is dictated by the availability of water for both livestock and people and of forage for livestock. During rainy seasons herds are widely dispersed, while during dry seasons they are concentrated in the higher rainfall areas, where water and forage are still available. These dry-season-grazing areas are critical to the survival of the pastoral system because they allow the stock and the people to survive the period of greatest stress. To a large measure, these higher rainfall areas are the very areas that are coming under private control (through forage and other crop production or water supply control), thus restricting their availability to pastoralists. Should substantial portions of these areas become unavailable to the pastoralists for dry season grazing, alternative sources of feed must be found or overall livestock production in Somalia will be drastically reduced.

Mixed crop and livestock farming are combined to some extent wherever crops are grown. Some farmers maintain small herds of cattle, goats, sheep, and occasionally camels; these herds subsist on crop residues, household wastes, forages from cropped land, and forage from communal grazing lands. Animals which remain in villages and are provided with reasonably adequate diets during the entire year grow much more rapidly and in other ways out-perform animals maintained primarily on the rangelands. Small flocks of chickens, consisting of both indigenous and exotic breeds and combinations, are maintained by many village-based small farmers. They obtain most of their sustenance from household wastes, damaged grains, and by scavenging; much of their dietary protein is from the consumption of invertebrates. Neither crop nor livestock researchers have given much attention to means of increasing the productivity of combined crop and livestock farming systems.

Urban confinement systems of livestock production are common in and around the major urban centers. (There are said to be 40,000 head of cattle in Mogadishu.) Urban herds and flocks are the chief source of milk and eggs for the cities. Forage is transported to the animals, and limited quantities of concentrates are available, either on the open market or from governmental sources. Private poultry farms are increasing in size and numbers, but locally produced feed grains are insufficient to support the poultry industry and to supplement forages for dairy cattle.

Government-operated farms and ranches include a 3,700-ha dairy ranch at Warmahun, a 20,000-ha sheep ranch at Assura, a 1200-ha dairy ranch at Afgoi, a dairy at Geed Deeble with 4,000 ha of pasture, a 120-ha demonstration dairy and poultry farm at Qoryoley, dairy and poultry farms at Hargeisa, and others. Production levels achieved at these farms are low. An intensive poultry production unit is maintained at km 13 and a new one is being developed at km 15, near Mogadishu. Others are in operation or are planned. Because of difficulties in obtaining adequate feed supplies, egg production in MLFR farms has averaged approximately 40 eggs per bird year. This is about the same production level obtained from village chickens, which are fed little or no supplementary feedstuffs.

2.1.2 Marketing

Livestock and livestock products move to both domestic and export markets. Although it is assumed that the vast majority of livestock products are consumed in Somalia, no quantification of domestic consumption is available. Live animal exports are the principal sources of foreign exchange, and export of animals and animal products has generated at least 80% of the hard currency inflow in 5 of the last 7 years. In 1981, 92.6% of Somalia's foreign exchange came from the sale of livestock (Holtzman 1982).

Sheep and goats contribute at least two-thirds of the value of the live animal exports, with about 40% of the annual total shipped in the peak three months of the year, that is the (Muslim) month of Ramadan and the preceding two months. Sheep and goat exports have stabilized at approximately 1,400,000 head per year since 1978. Live cattle exports, second in value to small ruminants, have been increasing for the past two decades, and in 1981 exceeded 100,000 head. Camels, the most important subsistence animal, constitute only a small proportion of the export market.

In the last seven years, 90% of the live animals exported have gone to Saudi Arabia, leaving the Somali economy vulnerable to the vagaries of a single market. The Saudis express a strong preference for East African livestock, but they have repeatedly voiced their concern about disease control. It is important to satisfy Saudi animal disease requirements and to extend the export meat market to other customers, if at all possible.

2.1.3 Animal Health.

Diseases restrain livestock productivity, both by killing animals and by seriously reducing the productivity of those that survive. The technology for the control of most of the major epidemic infectious diseases indigenous to Somalia (rinderpest, foot-and-mouth disease, and contagious bovine and caprine pleuropneumonia), is available and in use. Endemic diseases (such as gastrointestinal and external parasites, enteric diseases, and pulmonary infections of young animals) cause serious loss of productivity, even though they do not always kill animals. Success in controlling both endemic and epidemic diseases is directly dependent on an effective animal health service; but the service provided by the animal health department of the MLFR is far from adequate, particularly at the producer level. Trypanosomiasis, spread by tsetse flies, is endemic in the Juba and Shebelle valleys and in parts of the interriverine area. A program is in progress designed to eliminate tsetse flies from this area. Trypanosomiasis in camels, where the pathogen is largely mechanically transmitted, is also a serious health problem.

Proportionately, the greater loss from diseases is a decrease in the productivity of livestock, but the death loss from disease also wastes huge quantities of animals and animal products. The team estimated mortalities of livestock for a nondrought year (Table 1). The number and value of animals that die from diseases each year exceeds the number and value of animals exported.

Table 1. Estimated annual mortality of livestock in Somalia during a nondrought year.

	Adults	Under 1 year	Total
Cattle	242,240*	245,268	487,508
Camels	211,700	185,237	396,937
Sheep	724,062	1,075,240	1,799,300
Goats	771,875	1,042,031	1,813,906

* Based on livestock numbers reported in Somalia in figures. The methodology reported by Holtzman was used in these calculations.

2.1.4 Inadequate Data Base

All livestock development and service programs are seriously restrained by the inadequate database on livestock production systems. No reliable data are available on production of vegetative matter on the rangelands, or on the influence of environmental and other factors on rangelands productivity. Almost nothing is known about the nutritional value of the wide variety of rangeland plants for the various livestock species under varying climatic conditions. Little reliable animal production data are available, such as morbidity effects, mortality rates, herd composition, reproductive performance, growth rates, milk production, and off-take of animals for domestic consumption by pastoralists. Little socioeconomic data has been collected on the pastoralists and the pastoral production system; the reasons they use various production strategies; the consequences to the system of induced changes; and which changes that maintain or improve productivity are also compatible with pastoralism. The lack of reliable data has severely restrained the planning and ultimate effectiveness of livestock development efforts.

2.1.5 Supporting Services

The Department of Animal Health (MLFR) is responsible for all government activities pertaining to animal health in Somalia. There is no private animal health sector. The main objectives of the department are to provide (a) curative veterinary services, for which it has a cadre of field veterinarians and veterinary assistants who diagnose diseases and dispense medicines, and (b) preventative veterinary services for the surveilance of infectious diseases and the administration of vaccines for their prevention. It maintains regional offices in all 16 regions, district offices in all 82 districts, and offices in 70 villages staffed by veterinarians or veterinary assistants.

The Serum and Vaccine Institute (SVI) in Mogadishu, assisted by an FAO/UNDP project, provides diagnostic laboratory support for infectious diseases and parasites; but it does not have capability for chemical or toxicological analysis. It produces the vaccines used for livestock in Somalia and occasionally for export.

Veterinary diagnostic laboratories are maintained at Kismayo and Hargeisa. The Kismayo laboratory, until recently partially supported by the Federal Republic of Germany, is a well-equipped facility staffed by competent personnel. Its activities have recently been crippled by the lack of support for supplies and transport. The Hargeisa laboratory, which was established with British assistance, is reported to be only partially functional because of lack of support.

The Department of Animal Health (DAH) is well structured and possesses adequate laboratory capability; but it is minimally effective at the producer level because of lack of support for its necessary and routine health service activities.

The Animal Production Department manages MLFR farms and ranches and provides support services to producers. It distributes dairy breeding stock, poultry, and bovine semen from improved sires to private producers. The dairy and poultry extension units serve as demonstration farms for private producers.

The National Range Agency (NRA), a semi-autonomous agency under MLFR, is responsible for development, administration, and regulation of the rangelands, including forestry and wildlife management. It is headed by a general manager who reports directly to the minister. Its activities include range and environmental monitoring, research, and training. It administers both the Northern Rangelands Development Project (NRDP) and the Central Rangelands Development Project (CRDP). It has offices in all the regions and a large field staff.

2.1.6 Potential for Improving Livestock Production

Considering the severe climatic constraints on rangelands productivity, it is not likely that the production of usable livestock forage on the rangelands can be economically increased much. The productivity of herds and flocks, however, can be increased, if some important constraints are removed.

A major factor limiting productivity of rangeland livestock is the shortage of feed during the dry seasons. During the dry season animals routinely undergo huge weight losses, which must be made up before additional growth can occur when feed supplies again become relatively plentiful. Thus 5 to 6 years are required to produce a bull of slaughter weight, rather than the 2.5 to 3 years required with a constant feed source.

Present losses to productivity from disease could be cut substantially (with a favorable benefit-to-cost relationship), with a properly functioning animal health service. The animal health delivery system could be improved by methodological research on the delivery of health services, but known health delivery methods would suffice if adequately supported. Losses from animal diseases are complete losses, reducing both the food available for subsistence and live animals for export. Efforts to reduce animal disease loss should be accompanied by measures favoring marketing of increased numbers of animals, or the consequence of these measures will be further overgrazing and destruction of the rangelands. Many deficiencies in the marketing system presently constraining the off-take of animals (see Holtzman 1982) should be corrected.

Assuming an improvement in dry season nutrition to animals, a reduction of animal disease losses, and improvements in marketing, further increases in productivity can be achieved by increasing the productive potential of individual animals by genetic means, and by improved animal husbandry and management practices. Particular attention should be directed to improving the productivity of mixed crop/livestock farming systems through research on forage crops, animal production, and farming systems. A 5% rate of improvement in productivity, as set forward in the Five Year Development Plan, is achievable only if needed improvement in supporting services (especially health and marketing) is agressively pursued, and an effective research effort is mounted to develop new technologies for the elimination of major restraints to the increased productivity of the sector.

2.1.7 Principal Development Projects

Many donors assist Somalia by financing development projects, and there are probably over 100 active projects in agriculture. Major donors funding projects of immediate importance to agricultural research include African Development Bank, World Bank, United Nations Development Programme, Federal Republic of Germany, World Food Program, International Fund for Agricultural Development, United States Agency for International Development, Canada, Sweden, Italy, United Kingdom, and others. Many large projects are funded by several donors, and some have several donors and their agents involved in implementation.

Central Rangelands Development Project, a large, multidonor project that was recently activated, attempts to improve livestock production and the welfare of the inhabitants of 149,000 km^2 of the central rangelands by: controlling grazing through the establishment of grazing associations and reserves; development and management of water supplies; and strengthening supporting institutions, including teaching and research capability in range management. Northern Rangelands Development Project is similar. Begun in 1977, it attempts to arrest the deterioration of the rangelands in a 140,000 km^2 area in northern Somalia by: establishing grazing and famine reserves plus fodder production units based on water spreading and harvesting; through stockwater development; by improvement in marketing infrastructure; and by strengthening supporting institutions.

The Artificial Insemination Center at Afgoi was established as part of a project to adapt techniques of collection, preservation, and use of bull semen in Somalia and to apply the principles of genetic improvement of dairy cattle to indigenous breeds. The project is nearing completion. A poultry project at km 13 (near Mogadishu) is developing information on intensive poultry production technology and encouraging the establishment of small poultry farms by distributing chicks and production information to prospective producers. A poultry project at km 15 will establish a large, intensive egg production operation. The Trypanosomiasis and Tsetse Control project seeks to eradicate tsetse flies to control trypanosomiasis and to establish a monitoring system to detect reinfection. The Kismayo Veterinary Diagnostic Laboratory project, recently completed, has provided a laboratory, equipment, and trained staff for southern Somalia. Numerous animal production projects, such as Warmahum Dairy Farm, Quoroley Dairy and Poultry Extension Farm, the Dairy Farm at Afgoi, Training School for Animal Science at km 7, the Assura Sheep Farm, Hargeisa Veterinary Laboratory, and others are still in operation or have been recently completed.

2.2 Crop Agriculture

2.2.1 Crop Production

About 20% of the population is engaged in crop production. While eight million hectares are classified as cultivable soils, availability of rainfall and irrigation places such severe restrictions on crop production that only 10% of the area is cultivated. Sorghum, maize, sesamum, and pulses are the principal food crops, occupying over 90% of the cultivated land. Cotton, sugarcane, banana, citrus, groundnuts, and rice are important minor crops (see Table 2), while banana is the only significant export crop.

The major crops on the 60,000 ha that receive controlled irrigation are maize, sugarcane, and bananas. Sugarcane and rice are produced on state-owned farms using capital-intensive methods, while bananas are produced by fairly large private farms. Smallholders apparently have little access to highly productive irrigated lands. Both public and private sector irrigated farms appear to be important employment sources, since some 215,000 people are reported (World Bank 1981b) to gain their living from controlled- and flood-irrigated agriculture.

About 600,000 people produce rainfed crops on 540,000 ha, where sorghum is by far the most important crop. Maize and sesamum are grown under rainfed as well as flood-irrigated conditions, while groundnuts and pulses are important rainfed crops. Most of the rainfed cropland is cultivated by hand (hoe culture), but a few farmers hire tractors for primary tillage. Animal traction is not common, and labor for weeding probably limits the area planted. Seed and labor are generally the sole physical inputs. Production per unit area is low, primarily because of the low and unreliable rainfall, but also because of lack of moisture-conserving production practices and higher yielding varieties.

2.2.2 Marketing

All crops except banana and some citrus are grown for home consumption or the local market. The Agricultural Development Corporation (ADC) is charged with purchase and marketing of grains and oil crops, while marketing of banana and citrus is supplied by the National Banana Board (NBB). Neither ADC nor NBB seems to use a substantial base of market information for setting prices, and a parallel private market appears to function for food grains. ADC estimates that they buy 15% to 20% of grain production and that another 10% moves in the parallel market, at substantially higher prices than those paid by ADC. From 1971 to 1978, while the banana export price doubled, the producer price increased by 40%. Although banana is the most profitable crop in terms of gross margin per man-day, production declined from 188,000 tons in 1972 to 72,000 tons in 1978. Area decreased by 5%, but yields declined from 26.5 to 14 t/ha (World Bank 1981b).

Estimates of area and yield of major crops are presented in Table 2. Considering the discrepancies in crop statistics presented by different sources, the figures in the table should be considered as only reasonable approximations.

Table 2. Estimates of area and yield of major crops in Somalia.

	Area cropped (000 ha)	Yield (t/ha) Rainfed	Irrigated flood	Irrigated controlled	Source*
Food Crops					
Sorghum	329	0.3-0.5	0.6-0.9	-	1
Maize	147	0.25-0.4	-	2.5	1,2
Sesame	52	0.25	0.6	-	1
Groundnuts	4	0.3	1.5	-	1
Rice	1	-	-	2.5	1,2
Pulses (a)	-	0.2	-	1.5	1
Cassava	-	7.0	-	-	1
Export Crops					
Banana	7-10		-	16	1,2
Citrus	4		2.0	-	1
Agroindustrial Crops					
Sugarcane	6		-	45-58	1,2
Cotton	15		0.7	-	1,2
Vegetables					
Onions	-		15		1
Tomatoes	-		10		1

*Sources: 1. Food and Agriculture Organization of the United Nations. 1977. Water use in irrigated agriculture, Democratic Republic of Somalia, a country brief. Rome, FAO.

2. World Bank 1981b.

(a) Refers to different legumes, including mungbeans, lima beans, and cowpeas.

Present yield levels indicate good potential for improving yields of all crops produced under controlled irrigation. Higher yields will depend upon better production technology and, if improved water control and delivery facilities are needed, a more favorable investment environment. Yields in the flood-irrigated areas also allow much improvement, but the risk of water being unavailable at critical times will keep the input investment low, pointing again to the importance of enlightened irrigation water management practices. Yield increases in the rainfed crops will be more difficult to achieve, primarily because of the difficult soil moisture circumstances.

2.2.3 Supporting Services

The Ministry of Agriculture supplies several supporting services for crop agriculture.

* Research is the responsibility of the Agricultural Research Institute (ARI).

* Extension and training, seed multiplication, seed production, and credit are the responsibility of the Department of Production and Extension.

* Plant protection and pest control (including plant quarantine) are under the Department of Plant Protection and Locust Control.

* Land and irrigation water development are under the Department of Land and Water Use.

* A tractor hire service is provided by the Farm Machinery and Agricultural Services Organization (ONAT), which is also responsible for import and distribution of fertilizers, seed, some chemicals, and spraying equipment. The imports are distributed through various enterprises and directly to farmers.

* The Agricultural Development Agency (ADC) provides marketing and credit facilities for food grains and oil crops. Seed is supplied on interest-free credit, and repaid in cash or produce. Cash loans are mainly for harvest expenses and repayable in 1 to 2 months at 7% per annum interest (World Bank 1981b). ADC is headed by a general manager who is responsible to the minister of agriculture. Its organization includes planning and marketing departments, and it provides market infrastructure, including warehouses (in 15 of the 16 regions) and trucks.

The National Banana Board provides production credit, inputs, and export marketing service to banana producers. Some development projects also supply agricultural services, and some seem to duplicate those supplied by the Ministry of Agriculture.

2.2.4 Development Projects

Several agricultural development projects impinge directly on research for crop agriculture. The UNDP/FAO project on Strengthening of Agricultural Research began in 1976. Its fairly general objectives include improvement of physical facilities at the central and regional stations; improvement of planning and design of agricultural research

programs; development of manpower for agricultural research; improvement of yield and quality performance of the currently grown cereal crops, legumes, horticultural crops, and cotton; and development of measures for efficient and economic use of agricultural chemicals and for reduction of post-harvest crop losses. A consortium of United States universitites (MUCIA) had a contract to implement the project until 1979, when FAO assumed executing responsibility. The project currently supplies a research administration advisor, a maize breeder, and associate experts in farming systems research and experiment station equipment management. The project has had substantial effect, particularly in the areas of designing research programs and establishing on-farm trials. The project was designed to cover only research to serve the crop sector.

Canada, through International Development Research Centre (IDRC), provides technical assistance, physical resources, and training to improve sorghum research. This assistance is well coordinated with the Bay Region Development Project and other research activities in ARI.

Funded by several donors, the Bay Region Agricultural Development Project started in 1978 with the objective of increasing crop and livestock production in the Bay Region, which includes most of the higher rainfall rainfed cropland in southern Somalia. The project provides institutional and infrastructural support for integrated agricultural development. A research component in the project is to conduct pre-release tests of crop varieties and on-farm trials under rainfed conditions. The project includes some assistance for the development of the research station at Bonka.

The Agricultural Delivery Systems Project is part of a multi-donor program to upgrade farm management and the national extension service. Its objectives are to revitalize the extension service, to train extension personnel, and to formulate the national agricultural research policy. The project uses the "training and visit" approach to technology diffusion. It covers 10 of the 16 regions in the country and includes all regions having significant crop production. The project has 135 field assistants and serves 70,000 of the 195,000 farm families in the regions covered. Crop husbandry demonstrations on project farms are used by subject matter specialists to train field assistants. As part of the USAID contribution, Utah State University provides an eight-person team to teach extension methods and help train subject-matter specialists. The project includes on-farm verification trials, which are planned and organized by the projects' subject-matter specialists in consultation with ARI scientists. On-farm trials have been done on three crops, with about five trials in each of the ten regions.

Government of Italy, especially through the University of Florence, is assisting in the development of the Somalia National University. Several staff members come to Somalia to teach each semester, and many Somali staff have done postgraduate studies at Florence. This continuing relationship is coordinated by a technical committee within the Faculty of Agriculture of the University of Florence.

Canada is also assisting with staff development at the Somalia National University. A project financed by Canadian International Development Agency (CIDA) provides resources for the University of Saskatoon to train Somali staff in the faculties of agriculture, livestock, and animal

production, education and medicine. This three-year project provides opportunities for about eight Somali staff to do their course work at the University of Saskatoon each year. They will then return to Somalia and do their thesis research under the guidance of a resident University of Saskatoon staff member. Emphasis will be on forming a base for postgraduate education in Somalia.

The Seed Production and Improvement Project is to assist the government in producing high quality seed of sorghum, maize, sesame, groundnuts, and rice. ARI is to be the source of material for multiplication, supplying both the breeder seed and production and maintenance of foundation seed.

The Northwest Agricultural Development Project is to improve agricultural production in 200,000 ha in Hargeisa, Gabilay, and Borama districts. The project includes a research component to develop and test technology for the promotion of agricultural development in the project area.

2.3 Forest Resources

Forest resources in Somalia are few. Scattered low trees or open woodlands are found throughout most of the rangelands and in the north there are a few remnants of juniper forests above 1500 m. In the highlands of the northeast, Boswellia and Commiphora trees are sources of frankincense and myrrh. Limited acreages of mangrove forests are found along the coast, especially from Kismayo to the Kenya border. In the southwest, some dry evergreen forest is found. Fuelwood seems a major concern for the population centers, especially Mogadishu. The forestry unit in MLFR has a small project on fuelwood production and charcoal processing and is establishing a few sites to try several species for fuelwood production. An effort is also being made to cultivate Boswellia to produce frankincense. This team did not attempt to assess the forestry research needs.

2.4 Fisheries

Although Somalia has a coastline of 3,330 km, the continental shelf rarely exceeds 15 km in width, and the total shelf area is estimated to be 35,000 to 40,000 km^2 (Kaplan 1977). Much of the shelf is rocky, uneven, and steeply sloping, but limited trawlable areas are found off the northeastern and northern coasts. An important area of up-welling occurs off the northeastern coast, causing nutrients to be swept to the surface. Such areas found elsewhere have been reliable indicators of commercially exploitable fish concentrations. The potential of Somalia's fishing resources is still largely unknown for lack of research data, including data on catches. The research surveys which have been conducted suggest considerable potential for harvesting small pelagic species, large demersal species, and sharks and rays. A total of 800 to 1,000 tons of fish are purported to be taken from the Juba and Shebelle rivers annually. Little is known about the potential for pond-fishery development. This team did not address research to serve the Somalia fisheries subsector, which has been recently explored in detail (see World Bank 1981b).

2.5 Plans for Agriculture

According to the current development plan (Ministry of National Planning 1982), Somalia seeks to raise people's standard of living, provide gainful employment for all, and achieve social justice and individual freedom within a socialist framework. It seeks to accelerate growth in production, reduce urban-rural disparities, and maintain the productivity of its croplands and rangelands. Recognized major constraints at the national level include skilled laborers and managers, scarce financial resources, an inadequate price and wage system, and inadequate physical and institutional infrastructure. (Significantly, the need for improved technology to increase crop production is mentioned in the plan, but technology availability is not prominent as a recognized restraint — perhaps indicating an assumption that the needed technology will be available.)

Livestock is expected to remain the mainstay of the economy. Sector objectives include increases in production, improved marketing, further integration of crop and livestock production, and better management of rangelands and livestock. Improvement of animal health will receive emphasis, as will better range management. Range management interventions center on the establishment of reserved grazing areas, the formation of range cooperatives, and the development of watering facilities. (Such interventions were made in the northern rangelands and are being extended to the central rangelands, although their positive effect and economic return have not been established.)

Delivery of animal health services, with UNDP/FAO project assistance, remains a major program; emphasis is shifting from successful development of vaccine production and regional diagnostic services to nationwide delivery of field services, with special attention to the export staging areas. Other health-related projects seek to provide quarantine and diagnostic facilities in critical sites; to provide ectoparasite control facilities and to open up the riverine areas for livestock by controlling tsetse flies. Other projects will bring additional resources to government dairy, poultry, and sheep farms.

During 1974-79, agriculture received about 22% of the investment while contributing about half of the gross domestic product (GDP)[2]. Within agriculture, livestock contributed about three-fourths of the GDP figure, but received about one-third of the investment. Planned capital investments for the 1982-86 period will have agriculture's share doubling to 44%, but livestock will still get one-third of the investment in agriculture, while irrigation gets one-half. The priority for irrigated agriculture is obvious, and Bardhere dam alone is expected to require 57% of the development expenditure for the agriculture sector from 1982-86.

National objectives in crop agriculture include increasing production of sorghum, maize, sugarcane, fruits, vegetables, oilseeds, cotton, and rice, moving toward self-sufficiency in many commodities. Increased

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[2]Per capita GDP in 1981 was about Sh3300, (US$220) at current official exchange rates, Sh15 = US$1. Various exchange rates are used in planning figures.

irrigation water-use efficiency is a priority, as are better dryland farming techniques and better integration of crop and animal husbandry. An annual growth rate of 6.2% in the value of crop agriculture is sought, and producer prices have been increased recently to stimulate production and sales. Research emphases will include identification of improved varieties of the major crops, improved production practices and cropping systems. Projects are underway or planned to strengthen agricultural research, seed production, extension training, and area development.

2.6 Research for Agricultural Development

Projects, which dominate the development scene, are largely structured with imported technology and outside experts. Until recently, most projects were designed to supply specific inputs and services, often with the assumption that doing so would increase productivity. Few opportunities were taken to try alternative technologies or approaches as pilot projects. Generally, a single approach was assumed effective, and experimentation was not seen as a tool to test alternatives. While this was true in all sectors of agriculture, more use of experimentation has been made in the crops sector to develop usable technologies than has been the case in livestock or irrigation water management sectors. Some livestock projects and service activities were used to collect important baseline data on factors affecting herd productivity, but there has not been a concerted effort to expand the base of reliable data so future services and development efforts could be more productive.

Research is mentioned as a tool in the crops sector of the current plan (and resource survey in water resources), but is not prominent in the livestock sector. Generally, the development plan seems to assume that solutions to problems are known and only need to be applied. Inadequate knowledge is not mentioned as a constraint, although planners recognize that the statistical base is inadequate. Science, as development of a better database or as experimentation, is not clearly evident in the plan as an important development tool to serve Somalia.

CHAPTER THREE : Role of Agricultural Research

Somalia has a steadily growing population that depends on agriculture for its food, employment, and export earnings. Despite its large area, most of Somalia's productive land base is already being exploited. The potential for marine fisheries along its coastline is relatively untouched and unknown. There is a small area of "frontier" land to be opened up using existing patterns of agriculture. Most of the needed additional production will have to come from the land resource base that is already being used. Production increases will have to rely heavily on increasing productivity through improved agricultural practices, including livestock husbandry, range management, crop husbandry, and irrigation water management. Increases in productivity result from using better technology, the primary product of an agricultural research system. The national agricultural research system thus needs to be seen and developed as an industrial research organization, supporting the major industry of the country.

3.1 Sources of Technology

To date Somalia has relied almost exclusively on externally developed information. Inviting experienced technical consultants to advise on development possibilities, and having resident expatriate scientists, brings Somalia conclusions from solid experimental research in other places. Properly interpreted, this information can be useful in Somalia, and the process of exploiting existing information will have to continue.

However, not all the information needed for Somalia's agricultural development can be imported. Most technology recommended by experienced consultants needs to be tested under Somalia's conditions before it can be safely used in major development efforts. Further, the more completely Somalia conditions are described, the better externally derived information can be fitted. Accurate descriptions and surveys of local conditions thus facilitate use of experimental results derived outside the country. Such information on local conditions, by its nature, must be obtained within Somalia.

Somalia cannot rely only on expatriate advisors and interpreters, and it should not rely only on resident expatriate scientists -- it must develop its own capacity to gather and interpret the rapidly increasing world knowledge of agriculture, test potential technologies before committing large sums to development projects, and when necessary create new technologies that are appropriate to local circumstances.

The development process cannot just wait for Somalia to build a substantial research capacity. Projects must go ahead, often on an uncertain and inadequate information base. But an increasingly skilled and experienced research service should be built up to monitor the progress of projects and learn from these experiences. This will give leads for research studies that will produce a steadily improved base for future development opportunities.

Somalia needs to adopt a deliberate and explicit policy to develop and sustain an internal agricultural research capacity to provide information for future development and to protect the profitability of the considerable development investments already made. Such an investment has been started, on a limited scale, for crops research in the Ministry of Agriculture, where the Agricultural Research Insititute forms a basis for developing a major component of a sufficient research system. However, there is no such research focus for the important livestock sector of agriculture. Some modest livestock research activities are underway in many departments and laboratories, but there is no focal point for livestock research and no recognizable investment in it.

The actual level of investment in national agricultural research is a matter for careful consideration and strategic choice by the government. The review team urges that a consistent allocation be made, and that the amount be related to the value of production in the agricultural sector. Government should then expect the agricultural research system to become increasingly competent in solving Somalia's agricultural production, marketing, and policy problems, and in taking advantage of opportunities to increase productivity in this major industry.

3.2 A National Agricultural Research System

During conversations in Somalia the team encountered a variety of ideas of what should be expected from agricultural research. A generalized account of what might be the role of the national agricultural research system in Somalia is, therefore, set out to provide a framework for further discussion.

3.2.1 The Purpose of Research

Broadly, research leads to an increase in knowledge, but the role of a national agricultural research system is much more specific. The goals of a research system to serve the needs of Somalia probably are at least three.

* The first goal of an agricultural research system should be to make available to the government, in an appropriately interpreted form, key elements of information on which effective agricultural policios and reliable development plans can be based.

The range of essential and useful information can be wide, for example: local and world-wide forecasting of markets; survey of national resources, including land, water, and people; analysis of hazards from climate, pests, and diseases; and technical details of production, storage, transport, and handling circumstances. Such information helps guide the formation of policies affecting agriculture, the choice of development projects, and the approaches followed in projects.

* The second goal of the research system should be to make available to farmers and herdsmen, through appropriate channels, the detailed management, biological, and economic information on which they can base their crop and livestock production practices.

Increased productivity requires the active cooperation of producers to complement supportive government policies and services. Research scientists can open new possibilities by developing improved practices that can increase productivity, but the producer is unlikely to adopt new practices unless it is clear that they are going to be beneficial in the producer's terms of reference. It is the researcher's responsibility to do sufficient research at the producer's level of management and resources to confirm that his recommendations are reliable for the producer. An essential part of the research task is the presentation of such information in a form easily understood by the recipients, both producers and extension personnel.

* The third goal of the agricultural research system should be to develop and maintain a group of well-trained, competent scientists in active research positions, capable of sustaining and interpreting national and international scientific advances for the benefit of national development.

To encourage creative research as soon as possible in Somalia, this implies a well-planned and implemented staff development program, ensuring systematic and rapid training to the levels needed and attainable by the individual. It further implies that those training technical agriculturists within Somalia should be actively involved in the nation's research program, and that the research system retains productive research scientists in active research positions.

3.2.2 The Nature of Research

One useful classification of agricultural research suggests that: basic research is the generation of new knowledge; applied research is the use of that knowledge to generate new technologies; technological research is the assembly of component technologies into new operational practices; and adaptive research is adjusting new practices to local circumstances and testing the practices for their benefit to the producer.

All phases need an imaginative approach, insight, and interpretive ability, but there are important restrictions on where the research can be done. Adaptive research and producer-level testing have to be done under local circumstances. Some basic research can be done anywhere, but the collection of data on environmental conditions is a form of basic research that must be done locally. A research system in a developing country will spend most of its resources on adaptive and technological research, but some applied and basic research will also have to be done.

A small national agricultural research service should concentrate on research that has to be done locally, using as much externally developed information as possible; but the latter requires that the research staff be fully capable of keeping abreast of basic and applied research done elsewhere. Provision needs to be made for ensuring that national

research staff have sufficient training and facilities to gain access to free world knowledge; and this implies adequate investment to utilize modern communication methods.

3.2.3 The Cycle of Research Functions

Regardless of the overall size of a research organization supporting agricultural development, there are several functions that have to be carried out for efficient operation. The actual mechanisms evolved to carry out the functions will depend on the circumstances in particular countries. These will be discussed later in this report.

The essential functions of a research organization are illustrated in Figure 1. The major clients of the research system are the policy makers and planners in the government and the primary producers. Their prime needs for information and better technology determine the key research priorities. The selection of research priorities is critical for the efficiency of the system, and the priority-setting mechanism needs to provide for both technical and administrative inputs. Not all needs can be dealt with; hard choices must be made.

When the main priority research problems are agreed upon, and shares of resources allocated, the scientists in the research service must formulate the research program. The research program is derived from the balance of needs for better information and technology, their priorities, and the potential for success in supplying the needed information or technology with the personnel, monetary, and physical resources available. Planners may play a large role in defining research priorities, but the resulting programs will depend critically on the technical knowledge, scientific imagination, and creativity of researchers trained in various disciplines.

The number of experiments and studies that can be carried out each year in Somalia will never be large, and the annual increment of knowledge gained will be small. It is thus important that the experiments chosen be on the most pressing issues, where new information will be most easily attained, and effective. Large developed countries can afford to have scientists making fairly free and individualistic choices of experiments (some on marginally relevant topics), and still make good technological progress on the relatively few that pay off well; but smaller countries can seldom afford this luxury. It is also important that experiments are chosen with a clear understanding of the existing production system, with a sound appreciation of what is feasible, and likely to be acceptable under present circumstances.

The manpower needed for research programs is assessed and trained if necessary. Suitable facilities and adequate operating funds are provided to enable the researchers to function effectively. Finally to complete the cycle, research conclusions from experiments, surveys, and reviews of world knowledge must be interpreted and communicated back to the major clients in a form readily understood and appreciated, so they can be incorporated into better agricultural policies, development projects, or production practices.

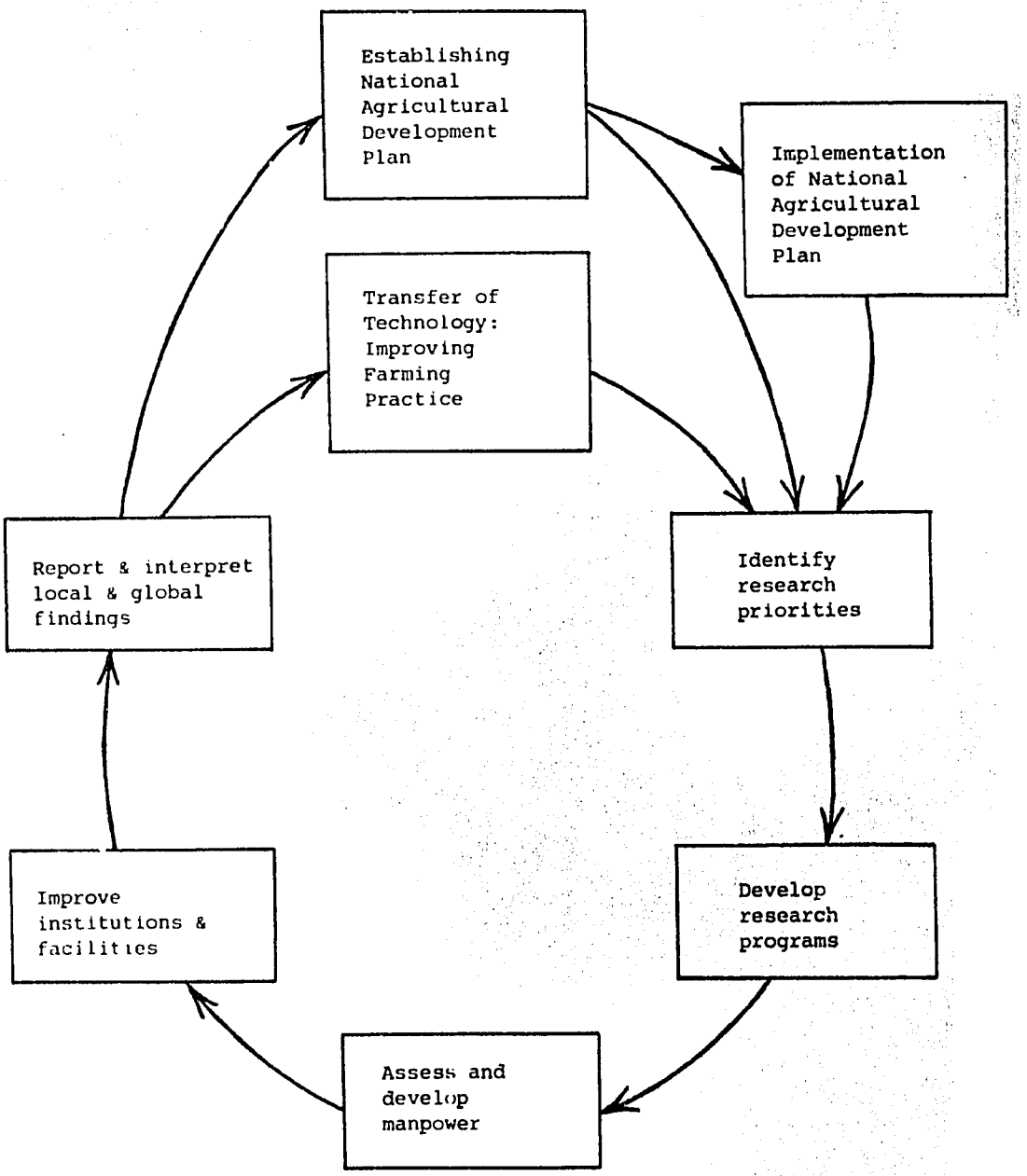

Figure 1. Essential functions of a research system.

3.2.4 The Essential Resources

Agricultural researchers apply a set of systematic approaches to the testing of selected hypotheses. Existing conditions and circumstances must be carefully considered before useful hypotheses can be formed, and evidence indicating acceptance or rejection of the hypotheses must be skilfully collected and examined. Researchers, therefore, need a set of skills that is usually obtained through an intensive course of study and practice at the postgraduate level. Manpower that is skilled in the necessary scientific disciplines forms a major limiting resource in the development of a research system in Somalia. The manpower (research capacity) needed to carry out the research program must be assessed and developed, with special training given where necessary, including training for technical support staff.

Suitable research facilities are also needed for a modern scientific research effort. This does not necessarily imply sophisticated equipment, but certain basic facilities are essential if the trained research scientists are to be productive. Adequate recurrent funding is essential for an aggressive research program. Generally in an economy having price relationships among capital equipment, consumable supplies, and salaries as does Somalia, funding for continuing operations (largely consumable supplies and daily labor) should be about the same as that allocated for salaries.

Some of the major issues involved in improving the performance of these research functions in Somalia will be discussed after a review of the current situation in the national agricultural research service.

CHAPTER FOUR : Current Agricultural Research

4.1 Historical

The various traditional patterns of crop and livestock management in Somalia were developed over long periods of time through trial and error. The practices adopted were well suited to the resources and markets available to the people. Such informal learning methods are too slow to keep up with present rates of change and expectations, which require introduction of a flow of modern scientific knowledge and technology.

Italian farmers in Somalia applied new resources with irrigation technology and tried a range of new crops and materials developed elsewhere to match new markets. These initiatives revealed new opportunities for agricultural development, but no formal research service was established to provide new information for development planning or to speed up the generation of new materials and practices appropriate to local conditions. Italian and British veterinarians identified the major animal disease problems and devised practicable means of controlling many of them, but no formal research entity for livestock research was established during the colonial era.

Before and after independence in 1960, many surveys were done, especially by the UNDP/FAO, which gained considerable information about rangeland and potential irrigated and rainfed cultivated areas. These were not, however, backed by many in-situ trials, nor with much training for research. In 1965, the government inaugurated a research service with technical assistance supplied through the University of Wyoming (U.S.A.). The Central Agricultural Research Station (CARS) was established at Afgoi, with irrigation, and later a substation was established for rainfed agriculture at Bonka (near Baidoa).

New crops and new introductions were tested at Afgoi under irrigated conditions, and preliminary recommendations were made for agronomic practices Several Somali staff were sent overseas for training as future research and extension officers. Research on rainfed sorghum at Bonka showed that recurrent selection over six seasons from local sorghums for earliness and yield gave appreciable yield increases and that moderate responses to fertilizers were possible. Some other rainfed crops were tried but few results are documented from this period. Attempts were made to introduce ox-drawn and camel-drawn equipment for land preparation at Baidoa and some ox teams were trained, but there was a marked shortage of suitable equipment and no local expertise for making ox-drawn equipment.

After the USAID-supported (Wyoming) project ended in 1969, the research division in the ministry continued, but it steadily declined for lack of consistent support. Some laboratories at Afgoi slipped into disuse, and many of the staff that had been trained took other jobs or left the country. A rejuvenation came in 1975 with the UNDP/FAO/ARI project to strengthen agricultural research. A team from the Mid-Western Universities Consortium for International Agriculture (MUCIA) provided guidance and support at CARS, and research stations were re-established at Bonka and Jilib. Many staff were sent for further training. A further break in continuity was avoided when FAO supplied technical assistance after the departure of the MUCIA team in 1979. The main theme of the project was to offer a nucleus of experienced research staff around which a national team could be developed.

By 1981, despite frequent staff transfers, the research staff in ARI had been rebuilt from 8 to 25, a reasonable base for developing future strength. Much of the expected benefit from staff trained to M.Sc. level was not achieved, however, as many who were trained abroad did not return to ARI or soon moved away. The retention of staff trained in agricultural research methodology at the postgraduate level remains an important problem for the young research service in ARI.

Other units of potential research workers have developed in the faculties of agriculture and veterinary medicine and animal production. The Faculty of Agriculture (FA), established in 1971, now has 26 Somali staff. (They are supplemented by about 14 part-time visiting faculty from the University of Florence, Italy.) The faculty has been much more successful than ARI in retaining staff. All 17 who returned from postgraduate training overseas are still in the faculty. The faculty has modest laboratory but no farm research facilities. Many of the staff are now working on research problems at CARS in collaboration with ARI.

The Faculty of Veterinary Medicine and Animal Production (FVMAP), established in 1974, already has 35 Somali staff (plus about 13 part-time professors from the University of Florence, Italy). It has retained all 13 staff that had overseas postgraduate training. FVMAP has considerable potential for research to serve the livestock industry, but the staff tend to follow their own research interests as there is no research unit to relate to in MLFR.

Despite the absence of a formal research unit in MLFR, there has been considerable research in the form of surveys of range potential and disease incidence in livestock, much of it by resident expatriate scientists. Three major veterinary laboratories have been established with the help of technical assistance projects (at Mogadishu, Hargeisa, and Kismayo), and these could become important centers for livestock research. (There was a reported decline in effectiveness of the laboratory in Hargeisa following the end of project support, and there is danger of a similar decline at Kismayo as project support has just ended.) There are also many state farm facilities that could be adapted and used as research centers. Information on primary range production is accumulating (even if not systematized), especially in the Northern Rangelands Development Project (NRDP), and some provision for further research is included in the Central Rangelands Development Project (CRDP). Somali researchers complain, however, that much of the information gathered in early years has been taken out of the country and is no longer available in Somalia.

4.2 Institutions and Programs

4.2.1 Livestock and Range Research

There is no focal point for livestock research in Somalia. Current research activities in the several units respond to some specific needs or opportunities within that unit. They are not designed to form a comprehensive research program to guide the development of the livestock industry.

Facilities that might be used for certain laboratory aspects of animal health research may be available in the Serum and Vaccine Institute (SVI) and at the diagnostic laboratories in Kismayo and Hargeisa. But vital facilities for housing animals, including isolation facilities, are not available at these labs. Field facilities for animal production and health research could be acquired by dedicating certain MLFR production facilities to research; such as the Afgoi Dairy and Artificial Insemination Center, Assura sheep ranch, the km 13 poultry farm, and possibly the Warmahun ranch. A small laboratory in the faculty of agriculture is being used on a temporary basis for analytical studies of rangelands vegetation as part of CRDP. An analytical laboratory and animal and laboratory research facilities for animal isolation, animal nutrition, and production research would have to be provided. Permanent laboratory facilities for rangeland research will be required, and field research sites need to be identified. Large rangeland experiment stations are not needed, in the opinion of this team. Instead, research on rangelands management strategies can best be done as part of experimental rangeland development projects.

Research activities in the National Range Agency (NRA) are largely limited to data collection and survey activities that are part of NRDP and CRDP. A resource inventory of the central rangelands is being conducted during both the dry and wet seasons by aerial survey techniques. This is to provide data on land systems in terms of geology, soils, vegetation, population, human habitation, water points, cropping activities, and numbers of livestock and wild animals by species. The aerial survey is being validated by ground observations. Data on the effect of utilization on the vegetation of the rangelands are being monitored.

Information on seasonal movement of animals and people, grazing patterns, grazing preferences, plant palatability, household composition and consumption is being collected in the CRDP. Data are being accumulated which will help evaluate the comparative effectiveness of various range management strategies, including controlling grazing through the use of grazing associations, cooperatives, and grazing reserves; forage production enhancement by water collection and harvesting; and management of water supplies for animals and people. The team estimates that about three scientist man-years (SMY) of effort are devoted to research in the collection and analysis of data by NRA. Research is not the central task of CRDP, and neither the level of effort nor the methodologies used adequately exploit this opportunity to gather and interpret data to guide future rangeland development.

The Department of Animal Health (DAH), in the course of providing services, collects important data on disease incidence and prevalence, effectiveness of vaccination and treatment procedures, numbers of animals, composition of herds, and similar information. The diagnostic laboratories routinely confirm the occurrence of specific disease agents, collect data on the prevalence of diseases, and, when necessary, work on means to improve diagnostic techniques. The SVI routinely conducts research on the biology of infectious agents and host responses to them, as necessary for the development and improvement of diagnostic tests, surveilance methodology, and new or improved vaccines. The SVI has initiated a cooperative research program with the U.S. Naval Medical Research Unit (located in Cairo) on diseases of animals transmissible to people. The team estimates that approximately four SMY are devoted to research in the SVI, but cannot quantify the research effort of the diagnostic laboratories or the animal health field services.

The Department of Animal Production (DAP) develops some information on animal production technology and management on the farms and ranches it operates as producing units. The base of knowledge about animal production in Somalia has been increased by DAP's production of forages under rainfed and irrigated conditions for feeding dairy cattle; the utilization of cross-breeding techniques to improve milk production; selection of techniques for improving production in native breeds of dairy cattle through use of artificial insemination; programs for improving small flock poultry production; and other livestock production and management strategies. Most of these efforts are not designed to produce reliable comparative data, and only a small proportion of the effort of the DAP is specifically devoted to research.

The Trypanosomiasis Control Project does field research on the biology of tsetse flies, trypanosomiasis in livestock, environmental effects of control procedures, and monitoring strategies as part of a comprehensive project to control trypanosomiasis in livestock in Somalia. The equivalent of about one SMY is devoted to research in this project.

Staff of the FVMAP conduct a broad range of research activities relating to animal health and production. Studies on nutritive values of rangeland and agricultural forages, agricultural residues, and industrial by-products are underway. A broad range of data is being collected on slaughter animals. Studies are in progress on: naturally occurring pharmaceutical products; control of both internal and external parasite infestations under Somali conditions; leishmaniasis (in the mongoose); brucellosis; bacterial infections; biology and husbandry of the camel; and other animal production and health problems. Laboratory facilities are adequate for the current research program, and equipment needs are modestly fulfilled, because many of the more detailed analyses are done in Italy. Clinical and animal holding facilities are inadequate, however, and much new equipment would be required if FVMAP were to accept more responsibility for research. The team estimates that 4 to 5 SMY are devoted to research by FVMAP staff. This will increase as more Somali staff complete advanced training.

The total research effort for livestock may be 12 to 13 SMY, with 3 SMY on collection and analysis of rangeland data, 4 on disease and parasite incidences and vaccine effectiveness, 1 on various aspects of trypanosomes and their vectors, and 4 or 5 on various subjects in FVMAP.

Generally, current research efforts on livestock (rangelands, animal production, and animal health) in MLFR are fragmented, not well coordinated, and not effectively focused on the major problems of the sector. Research on vegetative aspects of the rangelands needs to be intimately associated with studies on the nutritive values of range forages in animals. Studies on animal production systems for rangelands need to be coordinated with research on digestible feed resources available from the range. Knowledge about the social and economic determinants of the behavior of the nomadic pastoralists is fundamental to the development of improved range management, livestock production systems, health delivery services, and effective marketing strategies. Research on animal health must be closely linked to all aspects of animal production, and marketing research is fundamental to the development of the entire sector.

In many cases, research on crops also needs to be integrated with research on animal production and rangelands. The competency in nutrition, health, production, and marketing required for research on rangelands systems is the same competence required to address corresponding aspects of mixed crop and livestock systems. Research on farming systems must take into account both crops and livestock, while agricultural economics and policy research involves both livestock and crops.

4.2.2 Research for Crop Agriculture

Research to serve crop agriculture is generally the responsibility of the Agricultural Research Institute (ARI), officed in the Ministry of Agriculture (MOA). Staff of the Bay Region Development Project (BRDP), the Agricultural Delivery Systems Project, and the Faculty of Agriculture (FA) are also engaged in some aspects of crop research.

Major physical facilities of ARI are at the Central Agricultural Research Station (CARS), at Afgoi, 25 km west of Mogadishu. Regional research stations at Jilib and Aburein serve as testing sites, and one at Bonka serves both ARI and the scientific staff of BRDP.

The CARS station was established in 1964 under a USAID contract. It occupies 200 ha, of which 180 ha are cultivable, 80 ha have irrigation facilities, and only 40 ha are currently cultivated. Some 22 graduates are on the staff, and FAO supplies 3 resident scientists. Field facilities at CARS are generally available to staff of the Faculty of Agriculture. Facilities include housing for the director, 13 offices, 5 laboratories, a workshop, 9 stores, and a library containing about 900 textbooks and 30 periodicals. CARS is not connected with the electrical grid serving Mogadishu, but has a generator that is used part-time. Much of the laboratory equipment is in disrepair. Field equipment is modest but generally functional. Some imported machinery was not appropriate for the station. The fields need touch-up levelling, and the irrigation channels need rehabilitation.

The Bonka station, near Baidoa (some 400 m above sea level), was established in the 1950s to serve research and extension. Reorganized into a regional research station for rainfed crops in 1964 under the

USAID-University of Wyoming project, it is presently administered under BRDP. Its resident research staff includes the director, 5 Somali graduates and 1 expatriate scientist. Four staff members belong to the project, while the director and one scientist are with ARI, and the expatriate scientist is supplied by IDRC. The station is located on 20 ha, of which 12 are used. Other facilities include a house for the director, four stores, three offices, two laboratories and a small library containing about 150 textbooks. Equipment, facilities, staff and operational funds are supplied by the project, ARI, IDRC, and UNDP/FAO. Nearby, there is a 100-ha seed multiplication farm and an extension center.

The Jilib station is located in a 500 mm rainfall area, along the Juba river near an irrigation development project. Originally established by Italian farmers in the mid-1920s to evaluate the performance of tropical crops, it was later used by MOA as a service center; in 1964 it was reorganized into a regional research facility. The station has one graduate, who is the director, two technicians, and five skilled workers. About 12 ha, out of the total 40 ha, are currently cropped under irrigation. The main crops being demonstrated in unreplicated plots are maize, groundnuts, rice, and sesame. There is a small collection of eight local varieties of banana. The station has a house for the director, an office, a small unequipped laboratory, three stores, an equipment shed and workshop, three tractors, a pump house, and a pump for irrigation.

The team was unable to visit the Aburein station. The station is reportedly rainfed and has one Somali graduate doing research, mainly on sorghum. It is some 30 km from Hargeisa, under the management of the Northwest Region Development Project Facilities include 40 ha of land, a house for the director, and three offices. The present director is slated for training at ICRISAT soon.

Research programs in ARI are to:

* develop better crop varieties and crop production methods;
* develop new practices and test them in farmers' fields for their economic and practical feasibility;
* study socioeconomic conditions of farmers to identify the main production and economic contraints;
* collaborate with extension to provide new information to extension agents.

Until recently the crops research program was a collection of activities developed by individual scientists. Recently the work has been reorganized through the formation of teams of researchers on various topics, including sorghum, maize, legumes, oilseeds, horticultural crops, and cropping and farming systems.

Maize research is concentrated on making selections from populations derived by crossing local and introduced materials, including lines from CIMMYT, IITA, and SAFGRAD. Selections are compared to a released cultivar (Somtux), which was derived from a local composite crossed with Tuxpeño. Yield is the major selection criterion. Agronomic trials examine populations, rotations, planting dates, and fertilizer rates.

There are no on-farm trials yet, but there have been some demonstrations on private land. Pathology trials include screening for smut and downy mildew resistance and relationship of grain mold damage to date of planting and seed treatment.

Sorghum research, assisted by an IDRC-funded project, concentrates on selection for yield under moisture stress conditions. Local collections and line materials from ICRISAT and other external sources are moving through a selection process. Some crosses have been made, and selections from F2s will be made this year. Selection for drought tolerance will be followed by selection for resistance to stemborers and covered smut. Farm surveys are influencing research priorities, and current agronomic research examines plant populations, crop rotation, interplanting, and weed control effects.

Cropping systems work includes effects of intercropping, spacings, and rotations, especially with cowpea. The economic and labor requirement effects of row planting are being examined. Farming systems work examines the cultivation practices of defined groups in two benchmark villages and evaluates the economics of recommended practices under farm conditions. The latter program includes some 20 trials in two irrigated areas and expects to do similar trials in rainfed areas. These scientists, including an FAO associate expert, expect to bring more consideration of economic factors to all ARI research efforts.

Horticultural research includes grapefruit rootstock evaluation, variety testing, and weed control effect; the rice, pulses, vegetables, and oilseeds programs focus on variety evaluation and agronomic practices.

In Table 3 the scientific manpower available to ARI is set out in terms of man-years per year by discipline for each commodity, including 14 members of FA doing part-time research at Afgoi (13 rated at 0.3 man-years, 1 at 0.7 man-year). Some individuals work on more than one crop or in administration, and the fractions of their time for each crop or administrative and supervisory duties have been estimated.

The overall total, 32.6 man-years, represents 28 members of ARI staff and 4.6 man-years from FA. The largest research programs are, as expected, on sorghum and maize, with 4.65 man-years each. The cover of disciplines in even these teams is neither extensive nor deep, but these are useful concentrations on the most important crops. Large parts of the cropping systems and farming systems programs are also concerned with sorghum- and maize-based systems.

Table 3. Current distribution of research scientists of the Agricultural Research Institute by commodity research research program and discipline. 1983 man-years. At CARS, Bonka, Jilib, and Aburein.

Commodity or Activity	Total Man Years	Breeding	Crop Management	Entomology	Pathology	Soil Science	Economics	Horticulture
Sorghum	4.65	1.50	1.20	1.30	0.15	0.50		
Maize	4.65	1.60	1.20	0.20	1.15	0.50		
Rice	1.30		1.00		0.30			
Grain Legumes	2.30	1.00	1.00			0.30		
Oilseeds	3.10	1.00	1.80		0.30			
Forages	1.60		1.60					
Vegetables	2.60	1.00	1.60					
Fruit	2.00							2.00
Weed control	0.30		0.30					
Soil and Irrigation	1.70					1.40	0.30	
Cropping System	1.20	1.00		0.20				
Farming System	2.20		1.00				1.20	
Sub-total	27.60	7.10	10.70	1.70	1.90	2.70	1.50	2.00
Administration	3.00							
Supervision	2.00							
Total	32.60							

This table does not include expatriate project staff from FAO, IDRC, Utah or Wyoming, nor the four Bay Region Development Project staff assigned to research.

4.3 Funding

There is no functioning research entity in MLFR, even though there is a Department of Planning, Training and Research. There is no identified research budget for any of the units in MLFR. The team could make no estimate of the amount of money spent on the collection of data and creation of new knowledge in MLFR. The FVMAP receives funding for research from the university and modest support for specific research activities from agencies such as MLFR, National Academy of Science and Arts, and the Canadian and Italian governments.

Research in ARI is funded through normal government budgets. Development and operational budgets are drawn up by the director of CARS. These are submitted to and compiled, with estimates for other agricultural research activities by the ARI director, and submitted to the Ministry of Finance as part of the overall MOA budget. Funds are approved as a line item to MOA, which controls overall expenditures, but approval for operations budget expenditure for research is charged to the ARI director. Personnel and development expenditures are controlled directly by the MOA.

Regional station requirements for operating funds are submitted to the director of CARS and approval of their expenditures is by the director of ARI. Funds are usually released on time; however financial management in MOA appears to include decisions on allocations as well as the expected controller function. The director of ARI is sometimes unaware of the exact status of the research budget because there are no published budget figures, and funds allocated to the department may be adjusted in the ministry.

From information gathered, the team estimated that the total recurrent allocation to ARI for 1983, including the salaries and allowances of the staff, was Sh3.56 million (US$240,000), which supported the research of about 33 graduates. An estimate of the gross agricultural domestic product (GADP) for 1983 (based on the figures for 1981) might be Sh9,600 million (US$640 million), of which about Sh1,080 million (US$72 million) would be attributable to crops. The current allocation to ARI is, therefore, only 0.33% of the crops component of GADP. In 1982, ARI received an additional grant of Sh640,000 (US$43,000) from PL-480 funds (a United States program). A similar allocation made in 1983 would raise the ratio to 0.39%. Contributions to crops research outside ARI are relatively small, but the part-time research activity of 12 members of the Faculty of Agriculture should be added, along with 4 national graduates on the Bay Region project. This would add about Sh500,000 (US$33,000) to the total for crops research, which would raise the allocation from 0.39% to 0.43% of the crops component of GADP.

The current ARI operational budget is about Sh2 million (US$133,000). Ministerial allowances for research staff and day-to-day operating costs are both paid from this fund, so about Sh1.1 million (US$73,000) is available for operations. This amounts to about Sh32,000 (US$2,150) per SMY.

In addition to the ARI expenditures, there are several minor research expenditures. The National Academy of Science and Arts funds some small crops research projects at CARS and the university. The FA receives

funds for research from the university and some in-kind support from ARI for specific research projects. Research elements in development projects are funded from project funds and cannot be readily identified as research expenditures. There is no research budget in the National Banana Board.

4.4 Coordinating Mechanisms

Significant formal coordinating mechanisms have not developed either within or across ministries to assure that research efforts affect and are affected by national objectives and are mutually supporting. MOA and Ministry of National Planning (MNP) personnel have recently formed a sectoral committee that identifies constraints to (crop) agricultural development, formulates a development strategy, identifies required resources, and develops priorities. It is presumed that needs for improved technology and expansion of the database to solve problems or exploit opportunities will soon be concerns of that committee. Some two-way interactions between national objectives and crop research priorities may also develop in this forum. A similar committee for the livestock sector is not yet fully functional.

Research activities at the university largely reflect the interests of staff and students, with some consideration of national objectives, rural problems, and opportunities. There is apparently no formal mechanism for coordinating research among university faculties or with the other relevant ministries. There seems to be no formal mechanism linking research at the university with the national planning process.

The National Academy of Science and Arts (see Annex 4) includes coordination of research activities among its purposes. Within the academy, there is provision for a national research council, which has not been formed. As conceived, it would be composed of many of Somalia's senior scientists and chaired by the president of the academy. The council is seen as a body to formulate national policy on science and as a mechanism to keep the academy informed of current research efforts.

Informal coordinating mechanisms are more evident. Within crops research, the recently adopted research program formulation process (that indicates personnel allocations by discipline and program) includes the expected contribution of university staff in achieving specific objectives. Informal linkages between crops research and extension staff involve extension staff in on-farm testing of technology, but the mechanism for feedback of farmers' response to affect the research program seemed less well developed. Coordination of crops research efforts among stations is made more difficult by the inclusion of research (and station development) within area development projects. Two stations, Bonka and Aburein, are currently under the control of projects.

Research efforts within the various units of the Department of Animal Health (DAH), including field services, diagnostic laboratories, and the SVI, seem well integrated through personal communication. The research within NRA seems not well linked with animal production research in other sections of MLFR or with that at the university. Nor was the research on animal production in MLFR well linked with similar efforts in the university or with forage research in MOA.

4.5 Formulation of Research Programs

4.5.1 In the Ministry of Livestock, Forestry and Range

In keeping with the lack of a formally structured research effort in MLFR, there is no formal mechanism of research program and project formulation. Research on animal health is driven by the recognition of health problems for which control technology is inadequate. As problems arise in the field, causative factors of disease are identified and characterized by personnel in the diagnostic laboratories and the SVI. Preventive measures, including diagnostic tests and vaccines, are then developed and evaluated by the appropriate department within the institute. Specific research projects are largely determined by the personnel in the various departments.

Experiments and studies in animal production arise largely through the initiative of the various Department of Animal Production (DAP) farm directors and their staffs, and are designed to provide the solution to the major animal production and management problems experienced on that DAP farm. Research programs for rangeland problems have been formulated as part of the rangeland development projects, with considerable expatriate input. Research projects in NRA have been devised by project personnel, subjected to departmental review and concurrence of the director general. There is no framework in MLFR within which decisions on research objectives, priorities, resource allocation, program planning, and research project development can occur.

4.5.2 In the Faculty of Veterinary Medicine and Animal Production

Research within FVMAP is organized at the departmental level. Some departments have developed broad statements of research goals as a framework for research. For example, the animal production department has developed a statement of the major constraints to animal production in Somalia. Research projects conducted by staff are expected to contribute to knowledge about these constraints and the generation of technology which will contribute to their amelioration. The selection of research projects is by investigators, with the concurrence of department chairmen, who control research resources. The program and project formulation procedures in most departments are informal, depending largely upon agreement between the investigator, the chairman, and possibly a funding agency, on which problems should be worked on and what should be done. Informal contacts with MLFR personnel sharpen the perception of FVMAP staff of the importance of various problems.

4.5.3 In the Agricultural Research Institute and for Crops

Until recently, priorities, objectives, and methodologies of research projects were formulated by the officers concerned without much reference to the priorities expressed in the national development plan or, in some cases, of the clients. In the current UNDP/FAO project (Strengthening of

Agricultural Research in Somalia), significant effort has been placed on improving the procedures for assessing research priorities and planning and implementing research projects. There is now active collaboration between ARI and the extension service on problem and priority identification. Consultations among sections within ARI and between ARI and other institutions are not yet fully structured.

While much of the research program formulation in ARI is still an individual effort, the need for developing research programs through a multidisciplinary team approach is increasingly recognized. Multidisciplinary planning and implementation of experiments is at an early stage, but recently ARI has established commodity committees for maize and sorghum, composed of those research scientists in ARI, in the faculty and in projects whose work is directly relevant to the commodity. These committees, whose functioning is facilitated by ARI, are expected to promote personal and institutional collaboration in identifying, formulating, and implementing research projects. A framework for other crops and subjects has been worked out but awaits recruitment of appropriate scientists.

ARI has recently set forth its allocations of manpower by commodity and discipline (see Table 3, page 32). The functions of individual sections and units have been defined for eight research programs, and a general job description for researchers has been prepared. With the help of UNDP/FAO project staff, ARI has thus established a framework for planning and implementing research programs that brings available resources to bear on important problems and opportunities and provides for changes over time.

4.6 Conditions of Service

Research personnel frequently mentioned conditions of service as a major restraint on productivity and stability. The factors usually mentioned were inadequate salaries, lack of a career structure, and lack of rewards for research performance. Salaries for graduates in regular government service are fixed in a specific salary scale. Most first-degree holders enter the research service at pay scale A8. Some are eventually promoted to pay scale A7. The base salary for A8 is Sh1,100 (US$73) per month and for A7 it is Sh1,280 (US$85). In addition to the base salary, researchers in ARI receive monthly allowances of Sh1,700 (US$113) (professional allowance Sh700 plus departmental inducement Sh1,000). The allowances do not vary with pay scale, so those at A8 receive Sh2,800 (US$187) and those at A7 receive Sh2,980 (US$199). There are no steps within a pay scale, so scientists who have worked for many years often receive the same salary as those just hired; those who are highly productive receive the same pay as those who are less so. Projects pay various, often substantial, allowances, so many prefer to work on projects.

Recruitment of personnel into research is largely the responsibility of the Ministry of Labor and Social Affairs (MLSA). There seem to be few position or job descriptions in research. The graduates hired have a uniform education and are often assigned by MLSA to various government units. Once persons have been assigned, personnel policies are reported to make it difficult to discontinue the services of less productive persons.

The starting salary for assistant lecturers and lecturers at the university is Sh1,600 (US$107) and Sh2,000 (US$133) respectively, and there are firm criteria for promotion. However, there are no periodic salary increments within a grade that can be awarded or withheld as an incentive for performance.

There have been some opportunities for personnel in ARI to improve their skills through further training, but many of those trained did not return to ARI. Two graduates are currently undertaking M.Sc. courses in India, and two attended short courses at IRRI and IITA. The director of ARI was selected for a short course in agricultural research planning (due in September 1983) at the University of East Anglia. Researchers at CARS generally thought that there was little regard for further training, since no reward is given for postgraduate qualifications. In the FA, a completed M.Sc. and a research record apparently warrant promotion from an assistant lecturer to a lecturer, but in ARI there is little perceived reward for experience, exceptional performance, or further training -- except for opportunities for employment on a project or outside Somalia. While the faculty has a greater pay increase between its ranks than does ARI and firm qualifications for promotion, in neither group can the performance of individuals be regularly reviewed and rewarded.

The team was informed by MLSA that there exists, since 1977, separate but parallel salary scales for scientific and administrative cadres, and that it is possible for scientists to be recruited in their salary scales and grades and to advance from the lowest to the equivalent of a director general without going into administration. In principle, this should be a positive factor, if there were also ways of recognizing and rewarding performance. There are no procedures for regularly evaluating and rewarding the work of research scientists, so the intended usefulness of this positive procedure appears to have been thwarted.

Retirement from government service is based on age and period of service. Compulsory retirement is at 40 years of age for women and 50 for men. However, individuals can voluntarily retire after 20 years of uninterrupted government service.

Housing also affects the stability and productivity of staff at CARS. Only the director of CARS has staff housing at Afgoi. Other scientists live in Mogadishu and commute daily. They receive a monthly housing allowance of Sh300 (US$20), which they consider inadequate. (Rent of an average two-bedroom house in Mogadishu is reportedly around Sh1,400 (US$93) per month.) Regional research stations also have housing only for directors.

4.7 Manpower

As indicated in section 4.2 and Table 3., some 33 to 35 scientist man-years (SMY) are devoted to crops and related research. Twenty-seven of these are at Afgoi. The team's efforts to get detailed information on the qualifications and work experience of researchers were not fully successful. Within ARI, where 18 of 22 researchers responded to a questionnaire, 6 indicated they had an M.Sc. or equivalent. Of those,

two worked in agronomy, two in pathology, one in pomology, and one in administration. Eight reported they had a B.Sc. and had worked less than five years. Generally, most researchers at CARS have a first degree in agriculture, no specialized training, and a few years of work experience.

As stated earlier, 16 of 26 in the FA have an M.Sc. or equivalent. The team was unable to collect detailed information on the manpower that might be expected to be involved in livestock research in MLFR and FVMAP, but 13 of the 35 FVMAP staff have advanced training. SVI and NRA both have a few Somali staff members with advanced training and could contribute significantly to a well-designed research program. Collectively, there are about 35 Somalis with M.Sc.-level training who work in units that could be expected to do agricultural research. Nearly 30, or over 80%, of these are in the two relevant faculties of the university.

4.8 Training Facilities

The Faculty of Veterinary Medicine and Animal Production, Somalia National University, located on the Mogadishu campus, offers a five-year course of study leading to a degree in either animal production or veterinary medicine. (The university will shortly move to new facilities.) The staff consists of 35 Somali nationals and 10 to 15 Italians; the number present at any time varying with the teaching load. Following a year of study of languages, physics, chemistry, and general biology, plus two years of animal biology, students spend their final two years in professional studies in either veterinary medicine or animal production. There is little opportunity for practical application of subject matter or acquisition of clinical skills in either curriculum. An active clinical program is needed and must be located in an area in which animals are available for clinical instruction.

Sixty students are admitted each year, of which 40 to 45 complete the curriculum, two-thirds in veterinary medicine and one-third in animal production. Unless opportunities for veterinarians and animal production specialists expand significantly, in either the public or private sectors, the supply of animal production specialists and veterinarians will soon exceed opportunities for constructive service.

The Faculty of Agriculture, also within the Somalia National University, but located at Afgoi, provides a four-year, eight-semester course of study. The first two years are spent on basic subjects and the last two on agricultural subjects. A course in range management, to be started in 1984, will be the first specialization. The faculty selects 60 students each year following a university entrance examination. There are high dropout rates during the first two years, with about one-third of the entering students graduated.

The staff includes 26 Somali and 12 to 14 Italian professors. Most of the latter come for one semester. The staff has four ranks, but all the Somali staff is in the lower two ranks. About half the Somali staff have received post-graduate training, most in Italy, but some in the United Kingdom and the United States. Currently, four are in training in Italy, two in Canada, two in the U.S., and two will soon go to the U.K.

Somali staff dedicate part of their time to research, and research is essential for promotion. Student research (in their last year) often forms part of a continuing staff research program. Currently, there are about 10 research programs, several in cooperation with CARS. The faculty has no field research facilities, so CARS makes available physical facilities. Laboratory facilities were not elaborate, but appeared reasonably adequate for teaching. Equipment seemed in good repair and used regularly. Additional equipment will be needed as the research function increases and as a postgraduate program develops.

4.8.1 Technical Training

A Technical School of Veterinary Medicine and Animal Science was established with UNDP assistance in 1967. It provides diploma-level technical training for animal health assistants, animal production assistants, laboratory technicians, and meat inspection assistants. Beginning in 1983, it has a three-year course of study for students who have completed their intermediate education. The course consists of a year of biological sciences, mathematics, and languages, and two years of professional courses. The third year is devoted mainly to subjects covering the student's area of specialization. A total of 120 students are admitted each year and most finish. There have been approximately 1,600 graduates to date, the majority of whom are employed by MLFR. The school has access to a poultry farm, a dairy farm, and a veterinary clinic to provide practical experience to students. Students also spend three months in field training during the inter-term recess. Graduates seem adequately trained as technical assistants for field and herd aspects of research on animal production and health.

The Agricultural Secondary School at Afgoi was established in 1973 to provide vocational training for agriculture. It is coeducational, under the management of MOA. Admission to the school is through a selection committee and is open only to intermediate-level certificate holders. Current annual intake is 80 students. The school is being expanded and re-equiped to undertake courses in range management and forestry.

The teaching staff consists of 28 Somali nationals and 4 expatriates. The curriculum was drawn up in 1974 by a UNESCO expert and updated in 1980. The first year is spent largely on general subjects (languages, basic sciences, mathematics, geography, and revolutionary studies), and the final two years are spent on professional studies emphasizing practical work.

While the curriculum seems adequate, the school is poorly equipped for training. There is shortage of transport, textbooks, and equipment. Of a total of 32 technical teachers, 22 are employed elsewhere and are part-time teachers. While they are technically qualified in their fields of specialization, they lack teaching methodology. Practical work for students is limited to demonstration plots, which have no irrigation and are not well maintained. If the curriculum were followed, the theory and practical coverage of the technical subjects would provide sufficient depth of knowledge for intermediate-level manpower requirements in agricultural research.

4.9 Communications

4.9.1 Links with the International Community

Research workers need linkages with other individuals and research centers to take advantage of relevant available knowledge to solve local problems. Knowledge of research results and current research can be obtained in various ways, including: by study abroad; attendance at international conferences, workshops, and training sessions; by visiting research laboratories; by careful attention to the published literature; and from expatriates involved in the implementation of development projects.

A significant number of scientists in MLFR have studied abroad, but there has been limited opportunity for foreign travel to meetings and conferences. Staff at the SVI were well aware of relevant research in major external laboratories, but visa problems have inhibited their taking full advantage of conference and training opportunities at the International Laboratory for Research on Animal Diseases (ILRAD) in Nairobi. Library resources are inadequate to maintain contact with major advances in knowledge about range and livestock elsewhere in the world.

There have been many studies and projects in the livestock sector since independence, with variable success in importing technology and establishing long term linkages with outside sources of information. Some projects brought useful links with external institutions, but in other cases, project work was conducted independently of similar work in other institutions, whereas using common methods would have enhanced the value of the data for both Somalia and other developing countries.

There has been sufficient input from outside the country over a long enough period of time for positive impact on animal health programs. Much animal disease control technology (that is, diagnostic tests, procedures for isolating causative agents, vaccine production, and disease control strategies) is highly transferrable and requires minimum adaptation to local conditions.

Importation of rangeland management technology is another matter. Rangelands management technology is generally not directly transferable to Somalia from such countries as Australia, Mexico, and the United States. Range management strategies for a nomadic pastoral system, with heavy off-take for subsistence and with communal rights to water and land, differ strikingly from management strategies appropriate to privately owned rangelands managed to produce meat as the single product. Useful contributions from western countries are thus limited mainly to what is known as range science -- knowledge about range vegetation, its nutrient composition, analytical methods, and water management. Consequently, it is important that linkages be developed with institutions experienced with the science and management of rangelands having characteristics and uses similar to the Somali rangelands.

The most relevant source of information on rangelands science and management for Somalia is the International Livestock Centre for Africa (ILCA). ILCA devotes its entire efforts to major African livestock problems. Much information has already been developed by ILCA on rangelands vegetation in arid and semi-arid regions, on the nutritive value to animals of African range and cultivated forages, on animal production techniques that are practicable under African social and economic conditions, on socioeconomic aspects of nomadic and mixed crop and livestock production systems, and on range management strategies. Research is in progress in all these areas and training programs are offered. The ILCA documentation center is the best collection of African rangelands literature in the world. The development of productive linkages between research elements in MLFR and ILCA must, therefore, be a high priority objective. Research linkages on disciplinary problems supportive of livestock and range research, such as genetics, reproduction, physiology, botany, analytical chemistry, virology, pathology, etc., should be established with strong centers wherever they may be found.

The FVMAP has developed strong linkages with Italian universities as a result of the Italian technical assistance program and the many Somali staff who have completed their advanced study in Italian universities. A new program to assist the university to develop a M.Sc.-level graduate program and to support research will provide strong linkages in animal production and veterinary medicine with the University of Saskatoon in Canada. Ties should also be developed by FVMAP with both ILCA and ILRAD.

Within the crops research group at CARS, relatively few people have studied or traveled abroad. Some of the staff in the FA have studied abroad (mostly in Italy), and additional external training opportunities are developing. Links with external researchers were evident in several crop research programs. The sorghum program was receiving germplasm from FAO, OAU/SAFGRAD, and ICRISAT. Within the IDRC-funded sorghum project, two staff members were doing M.Sc. course work in an Indian university and their research at ICRISAT. Vegetable research was effectively linked with Asian Vegetable Research and Development Center (AVRDC), Taiwan. Less fully developed but useful links with The International Maize and Wheat Improvement Center, (CIMMYT) Mexico and International Institute for Tropical Agriculture (IITA) were evident in the maize and grain legume research programs. Generally, crops research activities were sufficiently linked with international centers to get germplasm and lines for testing. Research managers could enhance their relations with centers to take more advantage of training opportunities and visits by center personnel. (Training at centers, of course, will usually require foreign exchange funding.) There was less indication of effective links with relevant research in neighboring countries; for example, with the sorghum and maize stalk borer research at the International Centre for Insect Physiology and Ecology (ICIPE) in Kenya.

4.9.2 Linkages within Somalia

The recent formation of commodity committees for sorghum and maize, facilitated by ARI (see section 4.5.3), has significantly enhanced communication among researchers and between research and extension staffs. When committees develop for other commodities, they will provide the needed linkages among researchers and between research and extension.

There is no focal point for research within MLFR, and there is no formal link between MLFR and FVMAP. Linkages among researchers in MLFR are largely informal, as are those between MLFR and FVMAP personnel. These are fairly effective within laboratories in DAH, and, to a lesser extent, between DAH and FVMAP.

Links between crops researchers and client groups of producers are mostly through the extension service. Some crops researchers meet with extension personnel to plan on-farm tests or demonstrations, so researchers affect what is tested or demonstrated. The needed feedback mechanism, wherein farmer responses affect the future research program, seemed inadequately developed. Field-level extension personnel indicated they would report problems to their superiors in Mogadishu, but not discuss them with their nearby research counterparts, whose programs should be affected by such information.

The main contacts of the animal health department with producers are through their 82 district and 70 village offices. There is a need, well recognized by the department, for mobile contact with the pastoralists during the periods when the latter are in the interior. Several schemes have been developed but not implemented because of lack of support. Pastoralists are said to be familiar with disease problems and seek contact with the department for drugs, vaccines, and advice.

The animal production department has minimal contact with producers. The department has established demonstration farms to disseminate livestock and poultry management information, hold short courses for livestock people, and distribute baby chicks, concentrates, and bull semen for artificial insemination. There is a strong need for an animal production extension service, which preferably would be established as part of the agricultural extension service.

The NRA is developing close ties with pastoralists through an informal education program of CRDP and through grazing associations established as part of CRDP and NRDP. However, it was not clear that project personnel saw this linkage as a learning situation that would affect their program.

Publications, including mimeographed reports on research work and commodity production guides, were in the library at CARS; the university publishes students' and staff research papers. There is no refereed journal of agricultural science published in Somalia, and few articles based on research in Somalia are published by Somali scientists in outside journals. The National Academy of Science and Arts has a substantial backlog of scientific papers awaiting publication on the government press. The extension service plans to have a publications unit with limited publishing facilities.

Links with planners are just developing. A committee has been formed recently that includes technical personnel from the relevant ministries and personnel from Ministry of National Planning (MNP) to help plan for agricultural development. While current projects and formal reports are the major guides for planning, this committee offers opportunity for researchers to affect development plans, and for planners to affect research programs. It must be noted, however, that many projects are planned by a Somali organization (ministry or parastatal) and a donor,

and MNP personnel become involved after many elements are agreed. To date, many projects seem to have relied exclusively, or nearly so, on outside experts for technical guidance. In some cases, Somali experts were not much involved, or their guidance was not followed. Interactions among MLFR, MOA, and MNP personnel could be much improved, especially for project planning and for choosing priorities among research subjects.

Currently, the Department of Planning, Training and Research in MLFR is the official link between MLFR and MNP, and the vice-minister of agriculture links with MNP for MOA. In principle, development projects (NRDP, CRDP, and BRDP), are implemented through the established departments and agencies within MLFR. For example, that portion of CRDP dealing with animal health is to be administered by DAH. In practice, general managers seem to run projects with little attention to the needs of the action agencies in their parent ministry.

CHAPTER FIVE: Agricultural Research to Serve Somalia

Somalia wants to enhance the well-being of its people by increasing agricultural production. The present productivity of the rangelands is to be held at least constant, improved if possible, with the resource base protected against degradation. Crop production is to be increased by over 6% per year, balance of payments is to be improved, and crops are to be diversified. There is little scope for increasing the area under production. Some production gains can result from the increased use of inputs, using present production practices, but most gains will have to come from increasing the efficiency of production of both rangelands and croplands.

Production efficiency can only be improved by using better production practices, the result of new or additional inputs or management changes from new insight into how the production system is working. If Somalia is to meet its development objectives in agriculture, it will thus need a flow of improved technology in the form of better production practices. Some of the needed technology can be imported, but much will have to be developed within Somalia. The needed technology can be systematically imported, developed, and used only when Somalia adopts a specific policy to use science, and the better technology it produces, as an integral and ordinary component of its development strategy. At the national level, agricultural research must be seen to contribute directly to achieving national goals and objectives.

The basis for agricultural research may be derived from either rural development objectives or a national science policy. Somalia has not separated out "science and technology" as a separate effort in a ministry of its own, as have some countries. Rather, it has implicitly recognized the role of science and technology as a major element within each of the main ministries. In the opinion of this team, this is the best procedure, for science should be firmly linked to the development industry it serves. (There is also residual need to preserve the unity of science in an inter-ministerial body, such as the National Academy of Science and Arts.) The ministries responsible for increasing productivity of livestock and crops depend on a flow of improved technology to meet their priority objectives; they cannot meet their objectives without it, and their needs should form the basis of the research program.

Presently, however, there does not appear to be widespread awareness that Somalia needs an "industrial research" capability to support the development of its major industry, agriculture. Within the Ministry of Agriculture, (MOA) there is a modest investment in research on crops, through the Agricultural Research Institute (ARI). But in the Ministry of Livestock, Forestry and Range, (MLFR) there is no specific commitment to research to safeguard and improve the livestock industry. This missing element is reflected in the development plan for 1982-86, where there is almost no mention of research for livestock.

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Generally, national planners for development have not yet come to expect any great contribution from research, but seem to be content with research information derived second-hand from other countries, mostly through expatriate consultants. Producers are not yet aggressively seeking better technology, so they are not outspoken about their needs that could be met by research. (In many developed countries agricultural producers are vocal in their demands from research.) Meanwhile, this latent demand must be discerned and voiced by the public sector, especially by those extension and research personnel having direct contact and understanding of the needs of producers. A demand for research products from the users will develop as research starts offering useful products. Somalia's growing agricultural extension service seems fairly aware of the large gaps in knowledge of how to increase productivity. Extension is most anxious for more research to be done to supply needed information, for they need more reliable packages of practices to offer producers. The researchers themselves recognize their role in providing information to extension and producers, but they do not appear to appreciate their responsibility to provide information for planning.

This report presented in Chapter 3 a rationale for Somalia to develop some national capability in agricultural research, rather than to rely entirely on advice from external consultants. Such advice can, at best, be based on interpreting conclusions for Somalia's conditions from research done outside the country. Much research and survey must be done within Somalia to supply essential information to development planners, to solve unique production problems, and to exploit unique opportunities. The team recommends, therefore, that the government of Somalia give a clear acknowledgment of the role of research and the resulting flow of technology in the development process, making an explicit committment to invest (within the relevant ministries) in the development of a national capacity for agricultural research to serve the major development industry.

5.1 Research Planning, Organization, and Management

Planning, organization, and management have major effects on the productivity of the research investment. Major elements needing attention in Somalia include the development of a comprehensive livestock research program; the integration of the relevant university staff into the research system; the establishment of a strategic planning mechanism to guide research; the development and implementation of priority research programs with the necessary integration across ministries; and the development, retention, and sustained productivity of the needed scientific manpower. Each of these will be discussed and some options presented for consideration.

5.1.1 Focal Points for Research

Within MOA, ARI forms a focal point for research to serve crop agriculture, including eventually, soil, water management, economic and social sciences. ARI will need to be greatly strengthened and to further evolve its role. As a focal point, however, ARI is conceptually sound, and its development is being ably nurtured through the UNDF/FAO project.

There is currently no comprehensive research program within MLFR and no focal point for research in livestock that would correspond to ARI. It is of prime importance to Somalia to have a focal point for the research needed for the development of livestock and range, the country's most important industry, and the preservation of the supporting natural resources. Such an entity would provide direction to research in livestock, range, and forestry, and would manage the research activities of MLFR. It would accomplish this by performing for the livestock sector the functions that ARI performs for the crops sector. That is, both ARI and the equivalent for livestock would:

1. plan effective and coordinated research programs on the priority areas identified by the proposed National Council for Agricultural and Livestock Research (see 5.1.2), with the funds allocated for that purpose;
2. manage the financial, physical, and human resources required to accomplish the research programs;
3. prepare specific research projects and conduct the research;
4. manage the communications and information network required to disseminate scientific information (resulting from internal research and from research data from outside the country which has been integrated into the information base by its scientists) relevant to the several missions of the development ministries.

The clients for these activities include:

* national policy-makers and administrators at all relevant levels of government;
* the service and action departments within ministries, including extension and demonstration agencies;
* other Somali institutions, such as the university, the national academy of sciences, and national credit agencies;
* direct users of information, such as pastoralists, farmers, marketing organizations, processors, exporters, and private businesses; and
* potential donors desiring to assist Somalia with its development projects.

The team recommends that a focal point be established for research to serve the livestock sector. The entity for livestock might be designated the National Livestock, Forestry, and Range Research Institute, thus corresponding to the Agricultural Research Institute. The decision to form such an entity would be taken by the government of Somalia through its regular processes and procedures. A key element in this process would be the leadership of the minister of MLFR. The specific objectives of the two institutes (or departments) would be developed by a new strategic planning body for agricultural and livestock research (The National Council for Agricultural and Livestock Research, see 5.1.2), as would overall operational procedures, general organization, and administrative style.

5.1.2 Interaction and Coordination of Effort

The effectiveness of the agricultural and livestock research system, both in providing technical guidance to policy-makers and planners and in solving practical production problems, is severely constrained because efforts are divided among many departments, institutes, projects,

laboratories, and agencies in the ministries of livestock and agriculture as well as the faculties of veterinary medicine and animal production and agriculture. Little coordination of effort occurs among some of these entities, even though two or more agencies may be engaged in research on the same or closely related problems. While some of the needed research in crops, soils, irrigation water management, livestock, and range management can proceed with relatively little consideration of research and development programs in other areas, much of it cannot without being grossly inadequate, uneconomically repititious, or both.

For example, research on forages is being conducted by the National Range Agency (NRA), Department of Animal Production (DAP), and in the Faculty of Veterinary Medicine and Animal Production (FVMAP). Closely related research on forage production is being done at the Central Agricultural Research Station (CARS) and the Faculty of Agriculture (FA), with little consideration given to the nutritional quality of forages and crop residues to animals. The various individual projects on forages all have merit, but they will not, even if continued as they are for many years, provide the data essential for enlightened rangeland management and mixed farming (crop/livestock) development projects. (Such projects must be based upon hard data on the nutritive value to various livestock species of rangeland and cultivated species of plants, under various environmental conditions.) On the other hand, if the resources currently dispersed to several units were combined in a carefully structured and integrated forage analysis and animal nutrition research program, the needed database on nutritional quality of animal feedstuffs could be obtained expeditiously.

In another example, if the physical aspects of irrigation water management in Somalia are developed without equally professional concern for the social, biological, and economic aspects (including consideration of the plants, animals, and people that use the irrigation water), the physical system developed may be grossly unsuited. This is an extremely expensive lesson that has been learned in many countries, one which Somalia can avoid.

These are but two examples of the current and potential widespread scattering of research effort among various departments, agencies, and faculties. The team believes it is essential for Somalia to develop a mechanism that will concentrate scarce research resources and bring them to bear in a coordinated manner on the solution of high priority constraints to agricultural and livestock productivity.

Establishing a mechanism for strategic and structural planning is critical to the development of an integrated and coordinated agricultural and livestock research system.

Strategic planning includes:

1. the definition of the national expectations for the agricultural and livestock research system -- what it is expected to do for Somalia;
2. decisions on overall policies for operation of the system;
3. determination of procedures by which priorities will be developed and ordered;
4. principles by which resources will be allocated to priority areas.

Structural planning includes:

1. decisions on the structure of the research organization, including identification of the operational units (laboratories, experiment stations, and institutes) which comprise the functional units of the research organization;
2. selection of organizational, administrative, and operational procedures;
3. identification of the roles of the various participants in the system.

Several countries have developed such a mechanism by constituting a council composed of the various officials who have policy or administrative responsibility for agricultural and livestock research. Such a council might be termed a National Council for Agricultural and Livestock Research. The council would be responsible for strategic and structural planning for agricultural and livestock research, both during formative stages and on an ongoing basis. Such a council might be composed of the ministers of MLFR and MOA (who would be co-chairmen), the vice president for academic affairs of the university, representatives of the ministries of planning and finance, and perhaps the director general of the proposed National Institute for Agricultural and Livestock Research, who would be secretary (see 5.1.3). The director of research for livestock, forestry and range, and the director of research for agriculture would usually attend council meetings. It might be advisable to have membership from other governmental agencies which function at policy levels above the ministries, but the council would need to be kept small so it could make difficult decisions on priorities.

The team recommends that Somalia establish a unified council to be responsible for strategic and structural planning of all agricultural research. The council would need a secretariat to prepare documentation for its decisions and convey its decisions to the research community. If, as suggested later in 5.1.3, the two focal points for research are merged as a National Institute for Agricultural and Livestock Research, the secretary of the council would be the director general and the two institutes would become constituent departments of the new national institute

If a decision is taken not to integrate strategic and structural planning for research on livestock and agriculture, separate mechanisms will be required for each ministry. The council for agriculture would be responsible for most of the research on crops, soils, irrigation water, and agroforestry. The council for livestock would similarly be responsible for animal, range, and forestry research. The major common areas of soil science, plant and animal nutrition, economics, and sociology would be duplicated in each. Each council would be chaired by the minister and be composed of some or all of the following: director general of the ministry, director of research for the ministry, a representative of the corresponding council, the heads of the chief development and service departments in the ministry, the directors of the major research institutions, the dean of the appropriate university faculty, and representations from the ministries of planning and finance and from the extension service .

If separate councils are used for livestock and agriculture, their independent decisions on priorities may cause critical aspects of research that should be shared by livestock and agriculture to go undone, to be attempted by inadequately trained personnel, or to be duplicated.

While separate councils for livestock and agricultural research would be some improvement over the current situation, it would fall far short of achieving the needed integration of research effort across these two ministries. As independent research efforts grow in separate ministries, they will develop more resistance to integration. The team considers separate councils a comparatively poor alternative and urges the immediate development of one council to be responsible for livestock, crop, range, soil, irrigation water, and agroforestry research, including physical, biological, social, and economic aspects.

5.1.3 Managing the Research Program

Integration of strategic, structural, and program planning for research is necessary for the large area of scientific intersection among livestock, range, agroforestry, and crop technology. The following options on the day-to-day management (program planning and implementation) of research assume that there is adopted a national council for agricultural and livestock research or an alternative form of joint strategic planning for agricultural and livestock research. The options are presented in the approximate order of the degree of change from the present circumstances their adoption would require.

Alternatives for managing agricultural and livestock research:

* Independent research institutes.

  Each of the two ministries might retain full and independent responsibility for implementing research activities. The two directors of research institutes would have collective responsibility to effect the needed cooperation in program formulation and implementation. They could establish and co-chair a coordinating committee that would include directors of major operational research units from both ministries and the deans of FVMAP and FA. Each ministry would have a line item in its budget for research. Specific priority for each research activity would be controlled by each director.

* A combined national institute.

  A new entity could be established under the ministries of livestock and agriculture with the mandate to develop an integrated and coordinated research program encompassing all areas of agricultural and livestock research. It might be called the National Institute for Agricultural and Livestock Research. It would be administered by a director general, who would report to the National Council for Agricultural and Livestock Research and be the secretary of the council. The director general would be assisted by a director of livestock research, a director of agricultural research, and an assistant director for administration. ARI and the corresponding focal point for livestock research would become constituent departments within the new institute. The budget for the institute would appear as line items in the budgets of each parent ministry, but would come to the institute directly from the Ministry of Finance. Financial management would be within the institute. It would be based on defined budgets for each program and would include controller functions. Facilities used for research in the two ministries would be assigned to this new institute. The institute

would have full responsibility for planning and managing the research program within the policy guidelines set by the council. The institute would make funds available to the relevant university faculties to do cooperatively planned research within the national program. Communication and working linkages would have to be developed with extension, service, and regulatory entities within the two ministries.

* A national institute under the university.

  The institute could be formed with the same internal structure and function as in the combined national institute described immediately above, but be attached to the National University. In one form, the university would accept only administrative responsibility for the institute. The development of the research program would be the responsibility of the ministries of livestock and agriculture, within the context of the institute and in conformity to council guidelines. Institute staff would be administratively under the university, but not part of the two relevant faculties. The budget of the institute would appear as line items in the budgets of the ministries of livestock and agriculture, but funds would come directly to the institute from the finance ministry. In an alternative form, the university would accept responsibility for generating the flow of technology necessary for rural development, and for making the needed contacts with primary clients, (technology users, policy-makers, and the extension service). Some staff of the university would hold dual appointments to their faculty and the institute, with ordinary responsibility for both research and teaching. The research program would be responsive to the council. The budget of the institute would be defended by the three ministries. It could be either a line item in the university's budget, or in the budgets of all three ministries, but funds would come directly to the institute.

* A national institute under the academy.

  The institute could be formed with the same internal structure and function as referred to above, but attached to the National Academy of Science and Arts for administrative purposes.

* A national institute under a new ministry.

  The institute could be attached to a new ministry of science and technology. This would be about the same as an institute under the academy, since in either case the parent unit (the academy or a new ministry) might form other such institutes for medical, social, or engineering research.

The national-level agricultural research management system chosen by Somalia should reflect consideration of several factors.

* First, the management system adopted should be as simple as possible to implement. Only change that is essential or highly desirable should be introduced.

* Second, it should be simple in function. That is, lines of authority should be direct, and there should be as few elements as possible. While many voices should be heard before decisions are taken, responsibilities for decisions, and for performance, should be clearly placed.

* Third, the management system should achieve the needed integration among research, development, and service efforts. Research far removed from development and service efforts is likely to serve neither of these well. Generally development and service efforts should both provide insight for, and be served by, the research system. Frequent effective contact among these three allow each to function at its optimum.

* Fourth, the system should achieve the essential integration of research planning, prioritization, and implementation, but not more than that. Research requires people to be innovative and to see opportunities for improving circumstances. Experience has been that the least control that will allow the research organization to achieve its objectives also allows researchers greatest freedom to be highly productive. It follows, therefore, that the control of the research process should be the minimum necessary to accomplish the objectives, and that researchers should be encouraged to use their initiative and imagination.

* Fifth, the management system should facilitate use of available resources. For example, the staff of the two faculties at the university are a major and growing resource of well-trained scientists, and the research system needs to make full use of them. Further, the staff needs to become an integral part of the research system to be fully effective as educators. The management system chosen should facilitate the full involvement of these and other university staff in the research effort, in ways that will both enhance their teaching function and contribute directly to the technology flow.

* Sixth, the choice of a research management system and its components should, to the extent possible, provide for the future of agricultural research in Somalia. For instance, if it is considered to be in the best interests of Somalia's longer-term rural development efforts to establish a physical focal point for agricultural research, say at Afgoi, then early decisions on the management system could substantially facilitate or make difficult such future actions. Factors to be considered in this regard include the working relationships between the staff at CARS and that of FA, and among CARS, the Dairy Research Farm and FVMAP. Decisions on the location of FA and FVMAP should consider the needs for field research facilities, their working relationships with crop and livestock research centers, and their relationships with other faculties in the university.

The concept of a community of researchers resident in the Afgoi area is an expansion of the latter consideration. As long as only a few research personnel are working at Afgoi, they will want to live in Mogadishu. Commuting cuts substantially into their working day and is not conducive to an aggressive research program. The staff at CARS forms a marginal

social group for the development of housing and other community facilities. If this community were to expand by the inclusion of FA and FVMAP staff, and the staff of a livestock and a poultry research center, the total research community would be well over 100 professionals and their families. Such a community could develop service facilities, including perhaps a school (or the upgrading of a local school), small shops, recreational facilities, and other social amenities that would encourage research personnel to both work and live at Afgoi. If this were done, staff of the two faculties would also need to be integrated into the broader university community, for example, through committee assignments and other ordinary staff interactions.

Certain advantages and disadvantages are associated with each option. As indicated earlier, the team assumes that Somalia will move to create a national body that performs the functions set forth for a national council for agricultural and livestock research (see 5.1.2).

The first option, independent research institutes in the two ministries, does not differ greatly from present circumstances. The livestock ministry, however, would have a focal point for research and could develop a substantial and partially integrated research program. This option presents little difficulty in that it does not involve much change, but neither does it accomplish much integration of effort across the two ministries. The interaction between the two directors of research would be based primarily on personal relationships, since each would report only to his/her minister. Their conformity to the guidelines of the council would reflect their ministry's adherence to council decisions, which could vary greatly over time. The important question of differing priorities between the two ministries for specific research would not be resolved; interdependent research, in which program components must go on in both ministries, would not be assured of equal priority in the two ministries. An interdependent research activity might proceed within one ministry but be of insufficient priority to warrant funding in the other ministry. Most importantly, the council would have no entity that directly responded to its priorities and related decisions. In most countries, research councils that do not control budgets and programs have not had much impact on what research was done.

The second option, a combined national institute for agricultural and livestock research under a national council, would be a significant change. This would be a fairly simple way to bring about the needed integration of work. Having the budget for the institute as line items in the budgets of each of the parent ministries would force the institute to respond to the needs identified by the two ministries in their development and service functions. The institute would respond to the two ministers, both in their position as minister, where they controlled budgets, and in their position as co-chairmen of the national council. The council, acting as a unit, would have a specific single entity to hold responsible for adhering to its guidance. Having full responsibility for planning and managing the research program, the institute would have a single list of priorities, solving the difficulty of assuring uniform priority for research elements that had to take place in two or more institutions at the same time.

The third option, that of forming a national institute under the university, would accomplish the management needs as efficiently as would option two. It could, however, be either a minor or a major change for the university, depending upon how much responsibility the university was given and accepted. If the institute were only attached to the university for administrative functions (essentially personnel management) and the ministries of livestock and agriculture were responsible for structuring the research programs, the university would not be much changed, yet this would allow efficient use of the university teaching staff in the research programs.

Giving the university full responsibility for the development and initial spread of agricultural technology would be a major change for the university, relieving the ministries of livestock and agriculture of direct responsibility for that function. While the concerns of the latter ministries would have a major influence on council decisions, there would be some amount of separation of responsibilities for development and for generating technology needed for that development.

The university, on the other hand, would benefit from such responsibility as a complement to its teaching function, especially at the postgraduate level. The university today perceives teaching as its primary function. While staff time is allocated to research, relatively few resources are made available for that function. As the university develops its postgraduate educational capacity, the research function will become more important. since research is integral to postgraduate education. Further, research done at the university will need to respond to the problems and opportunities of the people of Somalia, and these same problems and opportunities need to be reflected in the teaching function at the university. As the university develops its postgraduate teaching program, it will find itself being pulled into a more comprehensive research function. It is consistent with the development of this broader function for the university to accept full responsibility for generating the flow of technology necessary for rural development in Somalia. The functions of undergraduate teaching postgraduate education, technology generation, and interaction with the clients of research form an integrative whole that is commensurate with the responsibilities of a university. This would also bring all the agricultural research scientists into a single community with a common career structure. Such responsibility would also be consistent with the development of a community of agricultural scientists in the Afgoi area.

Restricting the reponsibilities of the ministries of agriculture and livestock to development and service functions, and giving the university total responsibility for technology generation, would be a major change. Experience in other countries has shown this to be an acceptable division of tasks, as long as the research program is responsive to development and service needs. This can be facilitated by including fairly firm distinction between teaching and research functions. While both are done by the same staff members, the teaching function responds to the normal university hierarchy, while the research program responds to the needs expressed in the national council for agricultural and livestock research.

Option four, that of attaching the institute to the National Academy for Science and Arts, places the responsibility for administering the research system in an institution (the academy) which is, as yet,

unprepared to accept that function More importantly, the academy is far removed from responsibility for agricultural development, supply of agricultural services, and postgraduate education.

The fifth option, that of placing the institute in a new ministry of science and technology, has approximately the same advantages and disadvantages as does placing the institute under the academy. Close working relationships among the research, educational (especially postgraduate), development, and service functions are essential. These working relationships are generally easier to accomplish if the research function is not so far removed from the other functions, as is the case when a separate ministry of science and technology is formed.

The team considers options four and five unacceptable, because they create an excessive gulf between functions of service, development, and technology generation. Option one is considered undesirable because it does not accomplish the needed program integration among ministries. Options two and three are both acceptable. Either could accomplish the needed integration of livestock and crops research, and either could accomodate the effective incorporation of relevant university staff into the mainstream of research to serve Somalia's agricultural development. Given the present circumstances in Somalia, option two may be more acceptable than option three, and the team recommends its adoption. Its adoption would not preclude the later adoption of option three.

5.1.4 Research Program Planning

When the national council has been formed, indicated the expectations from the research system, and the criteria for allocating resources, the director general of the institute, with the two directors of research and a few senior researchers, will need to make an approximate allocation of resources among priority areas and identify those scientists having first responsibility for defining each research program. Many programs will be identified with a commodity or a subject area, such as animal health, sorghum, irrigation water management, nutrition from forages, or livestock marketing. Some will involve only scientists from a single ministry, but many will need to involve lead scientists from two or more ministries and from the university.

For each priority research area, the scientists who will do the research need to formulate an appropriate research program, limited by the available resources. In the near future, the scope of the research program will often be limited by the availability of appropriately trained scientists and support staff, while non-personnel resource restrictions may govern the approach.

Detailed research program planning should begin with a statement of the current production system or circumstances of resource use. This provides the context for the research program, identifies major factors affecting the use of potential technology, and states a clear rationale for the research and how results are expected to mesh into the current production system. Then, research objectives are stated in quantitative terms, related to time, providing indicators for measuring progress. Research methodologies that provide efficient means to reach the objectives are agreed and stated. Having stated the specific objectives, time frame and methods, next are defined the manpower, monetary and

physical resources needed to do each part of the research program. Definition of needed resources will often reveal unacceptable assumptions in objectives, timing, or methods. If so, the program has to be recast to allow it to proceed with available resources, or delayed until essential resources are available.

Program priorities will require difficult decisions. The choice of criteria for assigning research priority is, of course, a matter for ministerial level (national council) decision. Without indicating priority of consideration or relative weight, the council may find some of the following criteria useful.

In allocating resources among commodities, resources, or institutions, consider the current and potential importance of the commodity, resource, or institution in relation to the:

* numbers of people affected, directly and indirectly, and their relative economic status;
* importance of the commodity in the daily diet, including economic variation;
* income generation effects on poorer people;
* labor, income, and other effects within a family or other social unit;
* foreign exchange generation or saving;
* contribution to GADP or value of resource.

In choosing among specific problems and opportunities within a commodity, resource, or institution, the following are added to the above considerations:

* the pervasiveness of the problem;
* the potential for the research to produce improved technology within a short time;
* the probability that the resulting new technology will be generally used by the target groups;
* the probability that someone else will not provide a usable solution to the problem;
* the contribution of the work to the development of the research capability.

5.2 Manpower Requirements

Although there are exceptional individuals who succeed without advanced studies, the Master of Science (M.Sc.) degree must be considered the usual minimal academic preparation for a productive agricultural research scientist Most first-degree holders do not have the background of knowledge and skills needed to conceptualize and implement agricultural research programs that solve problems and exploit opportunities to increase productivity. Research approaches to problem identification and solution and technology development are normally learned through a few years of postgraduate training and work experience.

Most Somali scientists now have a standard first degree in agriculture, veterinary medicine or animal production. A few have excellent postgraduate training to the M.Sc. or Ph.D. Since the M.Sc. is the

minimum qualification for most functional researchers, the force-paced, systematic training of the present staff to the M.Sc. (and some to the Ph.D.) should be a priority national objective, even while staff numbers are increasing and research programs are being defined. Within a few years, however, the M.Sc. should become the minimal academic preparation for entry into the agricultural research service as a research scientist. This will allow personnel training funds to be used for more specialized training and not to meet entry-level qualifications.

Somalia's agricultural base is large enough that effective demand for M.Sc.-holders will warrant development of M.Sc.-degree programs in a few disciplines in Somalia. These M.Sc.s would be employed not only in the research service, but also in teaching, other public sector services, and the private sector. The team's information base is not sufficient to identify these disciplines with much confidence, but disciplines having a replacement-plus-growth demand for two or more persons per year would seem to warrant developing an M.Sc.-degree program. Each M.Sc. trained outside Somalia will cost from US$20-40,000, so a relatively small consistent demand will support an internal M.Sc.-degree program. (Ph.D.s will have to be trained outside Somalia for several years.) Library and research facilities are shared and become progressively cheaper as additional degree programs are added, especially in closely related disciplines. Perhaps the planned national manpower study will help, but the faculties and university administrators will eventually decide which disciplines should have priority for developing M.Sc. training capability. Training to reach an M.Sc.-degree-granting capability should have first priority, since such capacity will drastically reduce training costs and perhaps make the training more useful.

A second major consideration in defining training needs is the current and expected allocation of researchers among commodities (or services) and tasks (or functions). This procedure has been used by ARI for research program planning, and Table 3 (page 30) indicates the current allocations in crops research. To illustrate planning specific manpower requirements, the team expanded the approach used by ARI to allocate researchers among commodities. (This illustrates the essential linkage among research program plans, available manpower, and manpower training plans.) The team assumed certain priorities and sets of tasks that more accurately describe the expected work than does the name of a scientific discipline. The important description of the commodity or resource in its context, which should be used to identify the priority research objectives, could not be done due to the team's insufficient knowledge. When this is done, the assumed problems and opportunities, resulting research objectives, and methodologies -- and hence required manpower resources -- may be different. Table 4, thus developed, is presented only to illustrate the procedure, showing that detailed manpower planning and research program planning are inextricably linked. It was developed by considering each commodity or service, its assumed priority, the research tasks that might require first attention, and where the work would need to be done.

Table 4. Indicative near-term distribution by man-months (MM) of researchers (M.Sc. and Ph.D. level) to commodity or service and to tasks.

Commodity or Service / Research Task	Crop Management	Soil (and water) Management	Crop Selection and Development	Insect Management	Disease Control	Production and Marketing Economics	Product Quality and Handling	Biometrics	Engineering	Rural Sociology	Totals (MM)
Sorghum	12B*;6A	6B(6B)**	12B;6A	6B;6A	6B;6A	6B	3(3)	3B		3B(3B)	81 (12)
Millet	3B(3B)		3B(3B)	3B	3B	3B				(3B)	15 (9)
Maize, irrigated	12	3(3)	6(6)			3(3)	6	3		3(3)	36 (15)
Maize, rainfed	12		6(6)	3B	3B	3		3		3B	33 (6)
Cotton, irrigated	12	6(6)	6(6)	9(3)	(6)	3	3(3)	3		3	45 (24)
Cotton, rainfed	12	3	6(6)	3(9)		3	3(3)	3		3B	36 (18)
Sugarcane	6Jo(6Jo)	6Jo(6Jo)	6Jo			3	6Jo	3			30 (12)
Banana	9(3)	9(3)	3		9(3)	3	6	3			42 (9)
Rice	6J	6J	4J	4J	4J						24
Citrus			6				6				12
Papaya			6				6				12
Mungbeans			4	3	(4)						7 (4)
Cowpeas			4	3	(4)						7 (4)
Groundnuts			4		(4)		4			3B	11 (4)
Sesamum			6				4				10
Oilseed alternatives			6				4				10
Tomatoes			4								4
Onions			4								4
Carrots			4								4
Forage crops	4(2)		4(2)			(3)	4(2)				12 (9)
Irrig. Water Mgmt.	(12)	12				6		6	12	12	48 (12)
Insect Control Services				6							6
Plant Introd. Services				6	6						12
Soil&Plant Anal.Services		12									12
Totals (MM)	94(26)	63(24)	110(29)	52(12)	37(21)	33(6)	55(11)	27	12	30(9)	513(138)

* Letters following MM designation indicate location, as follows:
A = Aburein; B = Bonka; J = Jilib; Jo = Jowhar; Unspecified = Afgoi complex (CARS, MLFR and University)

**Numbers in parenthesis indicate priority additions as resources become available.

Somalia's priorities may not correspond to those assumed in this illustration, and a new table should be developed accordingly. Near-term training needs, however, should be identified by allocating manpower to particular tasks. (Such a table also facilitates conceptualization and descriptions of positions.)

Not all tasks or commodities (and services) can be reasonably combined as the responsibility of a single person, and all training -- as all research -- must focus on the person as a unit. For example, considering only near-term needs, the 3 man-months (MM) of millet crop management, 3 MM of millet crop selection and 6 MM of sorghum soil management, (soil management practices for sorghum should largely suffice for millet), could combine as a single person to be trained in agronomy, with a minor in breeding, to be stationed at Bonka. The three MM on insect and disease control on millet and rainfed maize combine as a single person to be trained in plant protection, to be stationed at Bonka. Continuation of need is also a consideration, as is availability of the required training. The table does not help identify all training needs. For example, management functions are excluded, but they might be developed as another table.

First overall priority for training should go to those at the university who will serve as the major professors in the M.Sc.-degree programs. Since the present teaching programs will have to be sustained, this need will absorb relatively few training resources, but more than presently available under the Italian (University of Florence) and Canadian (University of Saskatoon) projects. Second priority, which should go on at the same time, would go to practical, M.Sc.-, and Ph.D.-degree training for those working in the higher-priority research areas. These are not difficult to identify in crops research, although some areas that are not currently receiving attention may be priority. Considering the numbers and training of the present ARI research staff, the first priority for ARI is for training of the present staff to the M.Sc. level, not for additional research staff. (Additional support staff will probably be needed when the researchers are better trained.) The numbers of scientists listed in Table 4 are extremely modest in terms of the work to be done. They reflect the constraints of likely training opportunities and of other resources.

Livestock, forestry, and range research personnel needs can only be roughly estimated at this time. As the research program is defined and implemented, training needs will be clarified. The team's estimates of the numbers of scientists that might reasonably be needed to staff the National Livestock Forestry and Range Institute are provided only to indicate the scale of program that might be appropriate.

The research program might include rangelands ecology, animal nutrition, animal production, animal health, livestock marketing and economics, livestock and combined livestock-crop production systems, and forestry. The general nature of the program in each area, and the approximate allocation of staff might be as indicated below:

1. Rangelands ecology. Identify the forage plant communities of the rangelands and provide quantitative information on their seasonal productivity under various climatic conditions and utilization strategies. Design and use monitoring systems capable of assessing changes in rangeland ecology and relate these changes to management strategies. (10 to 16 scientists)

2. Animal nutrition. Quantify through animal studies the nutritive value of the various components of the rangeland vegetation and cultivated forages for the principal livestock species. (6 to 10 scientists)

3. Animal production. Devise the means by which herd and flock composition and productivity data may be collected on a continuous basis for the various classes of livestock in rangeland and mixed farming systems. Identify the most effective production strategies for different ecological conditions and range management strategies. Improve the productivity of the various livestock species under rangeland or mixed farming conditions. (10 to 18 scientists)

4. Animal health. Identify the major animal disease problems among the various livestock species, quantify their impact on livestock production in Somalia, and devise means to control them economically. Develop an efficient animal disease surveilance system for Somalia. Through methodological research on the delivery of health services, develop an effective health services system for Somalia. (22 to 36 scientists)

5. Livestock marketing and economics. Provide analysis of the livestock marketing system from pasture to port or consumer and advise on means to improve the effectiveness of marketing strategies, procedures, and reporting mechanisms. Advise on economic issues of importance to the livestock sector. (4 to 8 scientists)

6. Livestock production systems. Develop a thorough understanding of the main characteristics of the nomadic pastoral system as it is practiced in Somalia, using standard sociological, anthropological, and economic research methodologies. Identify the main determinants of behavior relevant to livestock production and marketing decisions. Develop a base of knowledge about mixed crop-livestock farming systems as a basis for decisions on production practices that maximize the productivity of mixed farming systems. (6 to 12 scientists)

7. Forestry. Develop a database on the forest resources of Somalia, including important information on taxonomy, ecology, utilization, and productivity. Establish a strategy for development and proper utilization of the forest resources, including fuelwood and shelter belts Through research procedures, identify which of the forest resources can be made more productive and so better serve the needs of Somalia. (6 to 10 scientists)

8. Supporting services. Provide supporting services to research in library facilities, extension/research liasion, biometric analysis, and farm management and operations. (8 to 12 scientists)

9. Administration. Provide leadership and management in research organization, personnel administration, and financial matters, and communicate with policy-makers. (4 to 6 scientists/administrators)

10. Research station Provide competent scientists for on-going studies at field stations and administrative leadership and management of the field facilities. (10 to 20 scientists/administrators)

The first numbers would form a minimal (total 86 SMY), and the second a modest (total 148 SMY) level of effort for livestock research. Since many scientists would also have teaching and administrative duties, the total to be trained would be considerably more than those figures. A massive training effort for livestock researchers will be needed. Specific training requirements and their priority will be identified as research programs are planned, but a continuing training program with an intake of 12 to 15 researchers per year seems minimal in livestock .

Overall training needs are great and can be met only with a major sustained effort. There are now 30 to 35 Somali research staff having M.Sc. or higher degrees. A reasonable and attainable objective would be to have about 55 with M.Sc. and with Ph.D. in crops research and 145 in livestock research in 15 years. Assuming an annual attrition rate of 5% in the trained staff, and a 90% success rate in training (both are optimistic assumptions), a training program that accepted 20 entrants per year for 15 years, would, if begun in 1985, reach the objective by the year 2001.

The team urges that a training program be developed and implemented that will train Somali research scientists to the M.Sc. and, as needed, to the Ph.D., as rapidly as practicable. First emphasis should be on training those who will impart M.Sc.-degree training to others. The training effort ought to cover a 15-year period, expect to produce a modest-sized research staff of about 200 M.Sc. and Ph.D. by the year 2000, and develop capacity to continue to train to the M.Sc. in several disciplines.

5.2.1 Retention of Productive Research Staff

A successful national agricultural research system needs to recruit competent personnel, make maximum use of available manpower, and maintain working conditions that assure staff productivity and continuity of research programs. To do this the system requires effective recruitment procedures, promising career paths, and attractive conditions of service.

Research demands qualities that may be less vital for other jobs. Selection and recruitment for research positions ought to emphasize basic qualifications, evidence of creativity, desire and ability to learn, initiative and appropriate experience. These qualities also need to be strengthened and reinforced through personnel and program management procedures Stability of productive staff can be facilitated by having accurate position descriptions, well-defined research programs, an institutional environment conducive to productive research, periodic objective assessment of staff performance, rewards for competent performance, and transfer out of unproductive individuals.

Productivity and retention of research scientists are affected by a broad range of program and personnel management practices, not just salary. The institutional environment will have a major effect on the productivity of Somali scientists. The environment should provide reasonable resources for successful research, management procedures that facilitate field and laboratory work, an expectation of excellent performance, and an attractive staff development program including opportunities to develop leadership and management skills. Personnel management issues, however, will have to be carefully examined by government with a view to establishing mechanisms and procedures that will permit recruitment, retention, maximum utilization, and productivity of research personnel.

Position descriptions need to be written for each research and research management position. The descriptions should specify responsibilities to superior and subordinate personnel, responsibilities for accomplishing tasks, and guidelines on how tasks are to be carried out. Minimum qualifications and desired experience should be stated so that persons with adequate qualifications are hired. (Accurate job descriptions also facilitate periodic review of an individual's performance.)

As research programs are defined, specific responsibilities are agreed to by each cooperating scientist. These form much of the task "contract" and the scientist thus understands his or her obligations in each program. Periodic, objective performance evaluations are based on job descriptions, approved research program plans, and other defined responsibilities.

Experience in other countries indicates that the productivity of research scientists is highly dependent on personal motivation. Problems, opportunities, and productive research approaches are usually seen by scientists who aggressively seek them, not by those who do their work perfunctorily. Researchers thus need to be highly motivated to be imaginative and productive. Leadership and dedication to national and scientific advancement form part of the motivation, but personal rewards for good work must also be perceived. These usually include enhanced status, opportunity to affect research program content and management procedures, and monetary reward. Part of the latter may be granted as special honors, privileges, vehicles, housing, vacations, and similar one-time or infrequent rewards.

Regular salary increases for good work will be necessary to motivate most people. Progressive salary scales that include steps within each grade are thus needed for research scientists. Each grade should have well-defined minimum experience and qualifications for entry. Salary differentials among grades need to be sufficient to make promotion attactive, which they will not be if a low base is used and greatly supplemented by uniform allowances. Steps within a grade should contain enough salary differential to encourage scientists to continue to do excellent work. Advancement through the steps should not be automatic, but based on objective evaluation of performance. Steps should be time-related (either annual or biennial) but not so infrequent as to stifle desire and expectation. Provision should be made for multiple-step increases for truly outstanding performance.

The team recommends that Somalia develop and implement a management scheme for research personnel that will motivate sufficiently trained research scientists to be productive and to stay in Somalia.

5.3 Level of Investment

The level of investment is an issue for careful political judgment within the economic capabilities of the country. Some developed countries invest 4% and more of the value of industrial production in research. The World Bank (World Bank 1981a) has suggested that developing countries dependent on agriculture should aim at building up their internal research investment to 2% of the gross agricultural domestic product (GADP). Many developing countries already invest more than 1% of GADP (ISNAR 1981). Kenya, for instance, allocates 1.1% of GADP. The returns

on investments in agricultural research are often much higher than alternative public sector investments, so the level of investment in most developing countries, including Somalia, should be limited by the absorptive capacity of the research system. (See Ruttan, 1982 for a discussion of investment in research.)

Somalia's present investment in research to serve crop production (mostly at the ARI) is probably between 0.33% and 0.43% of the value of the crops component of the GADP (see 4.3). This is a low rate of investment in research for crops for a country so dependent on agriculture and expecting a 6.2% annual growth rate in crop production; it is low compared with rates in other developing countries. There is an urgency to set to work vigorously to improve crop and water productivity, because such improvement will have to sustain most of the growing population from the limited land resource already cropped. The team strongly urges that the level of investment be increased quickly to at least 1% of crops GADP, and that plans be developed to raise the level within 15 years to the 2% figure suggested by the World Bank.

It proved impossible to obtain an estimate of current allocation of funds and manpower resources to research in the livestock sector. If the team's estimate of about 13 scientist man-years (SMY) allocated to research in livestock is reasonable, it can be assumed that the total investment on range and livestock research in 1983 is not as much as 0.1% of the livestock component of GADP, which would be Sh7.7 million (US$513,000). An investment of 0.3%, which would be about equal to the current crop sector investment, would be Sh23 million (US$1.5 million). National trained scientific manpower and technical support staff may not be immediately available to absorb and utilize efficiently even that modest level of funding. With a concerted effort, however, a livestock research program could be developed over the next five years that would effectively use at least 0.3% of the livestock component of GADP. A 1% level of funding, equal to Sh77 million (US$5 million) currently, for livestock research could be absorbed efficiently after several years of careful planning and training of additional personnel.

The team urges that an explicit research organization be established for livestock research (see section 5.1.1) and that the level of funding be steadily increased to keep up with the (presently limiting) supply of trained research and support staff, until a level of at least 1% of the livestock component of GADP is reached[3]. Realistic targets could be a level of 0.3% in 5 years and, maintaining a 15% per year growth rate, reaching a 1% level in 15 years. At the present level of the livestock component of GADP, this implies supporting about 200 research scientists in livestock at about Sh375,000 (US$25,000) each. In the longer term,

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[3]This reflects collective experience in relative research investments. Research on livestock species that have long generation intervals often receives about half the proportional investment as does crops. Animal species that have short generation times may warrant greater relative investments because of associated higher returns.

the numbers of scientists that should be supported may level off at somewhat less than 200 SMY, since costs per SMY can be expected to increase[4]. As productivity of the livestock sector increases, research investment could also increase, if needed.

The additional investment in agricultural research would be in the form of additional funds for day-to-day program operations; maintaining basic experiment station and laboratory services, facilities and equipment; off-station research capability; manpower development; additional support staff; staff salaries and allowances; and some additional physical plant and equipment. The figures given relate to ordinary costs and exclude major one-time capital investments and foreign exchange for training and technical assistance.

5.4 Physical Facilities

The need for specific physical facilities will be revealed as research programs are defined. It is more important to upgrade the present crops research stations and to do more off-station research (which will require more operating funds and better trained people), than it is to build more stations. It is not clear, for example, that a new station is needed along the Juba, but it is clear that if the station at Jilib is properly located, it needs to be used as a center for experiments and on-farm tests in a number of research programs. Similarly, the station at Aburein could be an integral part of a national sorghum and millet research program, a major experimental site for other research programs, and a center for aggressive on-farm research in several programs.

The Bonka station needs to be developed to serve the rainfed agricultural area of southern Somalia. Its development under the Bay Region Project may be expeditious, but its longer-term role should also be considered. The team was not sufficiently informed to judge the suitability of the present site of this station. Approaching Bonka, one is impressed by the sudden increase in elevation. Before the present site absorbs many more resources for physical plant, one should carefully examine its representiveness of the rainfed area and the availability of sufficient land. Certainly, the 20 ha presently available at the site will not support a large rainfed crops research program, much less a combined crops/livestock research program.

The research programs of the new National Livestock, Forestry and Range Research Institute would be partially accomodated in existing laboratories, farms, ranches, experiment stations, and other facilities designated by MLFR as components of the new institute -- with the advice of the new National Council for Agricultural and Livestock Research. Some new facilities will have to be constructed specifically for the new institute for example, proper laboratories for the analysis of forages and the determination of their nutritional values in animals. In section 4.2.1, the team suggested that certain facilities, such as the Afgoi Dairy Farm, Artificial Insemination Center, the Assura Sheep Ranch, the km 13 Poultry Farm, and portions of (or perhaps the entire) Serum and Vaccine Institute, might be assigned to the new institute.

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[4]It should be noted that present investment levels per SMY for both livestock and crops are extremely low. Average costs per SMY vary greatly according to the research program, and the salary component may be minor.

The immediate need for improved research facilities is at Afgoi. The CARS facility warrants a major development program, including connection to the electrical power grid, approach road surfacing, field development, irrigation system rehabilitation, and major refurbishment of labs and equipment. If a decision is made to make Afgoi an agricultural research center, including the two relevant faculties and the dairy farm, consideration should be given to developing a residential community for all scientists and administrators. After such decisions were made, multiple family housing and necessary community services (clinic, school, shops, recreational facilities) could be developed as a project.

CHAPTER SIX : Summary of Conclusions and Recommendations

6.1 Agricultural Research in a National Development Strategy

Somalia's agricultural development requires advances on several fronts. The foregoing discussion emphasizes that flows of reliable information to government planners and improved technology to producers -- in the form of better production practices, inputs, management of water and soil resources and more efficient marketing -- are essential if Somalia is to meet its agricultural development goals. These are products of a research system. Some of the needed information and materials can be imported, but much will be unique and must be developed in Somalia by a national agricultural research system.

A number of decisions and actions are needed to facilitate the development of an agricultural research system that can both respond to Somalia's needs and be within Somalia's evolving capabilities. No effort to develop such a research system will have much lasting effect unless it has the support of government and a demand for information and technology is expressed by the main clients of the research system: the policy-makers, planners, and producers. A national scientific research service should be recognized as a major strategic element in the national development process.

> The team recommends that government, at highest levels, make a policy decision that a flow of information and improved technology from research will form a major component in Somalia's development strategy; that Somalia intends to exploit available external knowledge, adapt it to Somalia's circumstances, and, as needed, develop new information and technology. The government will need to indicate a level of internal resources that Somalia is willing to invest to accomplish the needed technology flow; then it must hold the research system accountable for performing its functions efficiently. The team suggests the level of investment be related to the value of agricultural production. Action will need to be taken by the Central Committee in concert with the ministries of livestock, agriculture, higher education, planning, and finance.

6.2 Agricultural Research in Development Ministeries

The research investment is currently being made mainly within development ministries, which the team commends In the Ministry of Agriculture, research is focused in the Agricultural Research Institute. The team commends the recent reorganization in ARI, but suggests that the level of investment be increased to permit greater breadth and depth of research in a wider range of crops and production techniques, improvement of facilities, and intensified development of research personnel.

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In the Ministry of Livestock, Forestry and Range, there is also an urgent need for a flow of information; unfortunately, Somalia has not yet established a focal point for research to serve the livestock sector. The flow of information needed to sustain the productivity of Somalia's rangelands and to increase the productivity of its livestock will require a major action research program. Carefully developed and integrated research is needed in rangelands ecology, animal nutrition, animal production, animal health, livestock marketing and economics, and livestock-crop production systems. For such a program to develop efficiently, there should be an effective focal point for research and support for an aggressive research program in the major units of the ministry.

> The team recommends that MLFR establish a focal point for research in the form of a National Livestock, Forestry and Range Institute to help develop and support priority research programs. Further, MLFR should allocate funds to technology development as rapidly as the institute can effectively absorb the resources. Such action should be taken by MLFR in concert with the ministries of planning and finance.

6.3 Level of Funding

The present level of funding of agricultural research in Somalia is not more than 0.4% of GADP for crops and less than 0.1% of GADP for livestock. This is low in comparison with other developing countries and with Somalia's needs.

> The team recommends that the level of investment be increased as rapidly as the system can effectively absorb it (constrained by the development of trained researchers and support staff) until it reaches 1% of the GADP. This level should be attainable within five years in the crops sector. If warranted, the crops sector investment should continue increasing until it reaches 2%. Realistic targets for the livestock sector would be a level of 0.3% of the value of the livestock component of GADP in five years, increasing steadily to attain a level of 1% in about 15 years.

6.4 Linkages with University Research

The qualifications of staff in the faculties of agriculture and veterinary medicine and animal production are similar to those required for the national research service. The talent of the staff in these faculties forms Somalia's largest pool of trained agricultural researchers. Their involvement in the mainstream of research to serve agricultural development will contribute immensely to Somalia's development and greatly enhance their undergraduate and postgraduate educational programs. This valuable resource needs to be effectively integrated into the research system.

> The team recommends that the research activities of the staff in these faculties be fully integrated into the national research system and that funds and facilities be made available to support such research, not only by the Ministry of Higher Education, but also by the ministries of agriculture and livestock, forestry and range.

6.5 Planning and Organization

Current research efforts in both livestock and crops are excessively fragmented, leading to inefficient use of resources. Some priority research can be done within a single department or ministry, but much of it requires a cooperative effort by scientists in two or more ministries. Not only must research within each sector be well planned, there are many areas of interdependence and commonality, and development needs in one ministry often affect the research program in another ministry.

> The team recommends development of a National Council for Agricultural and Livestock Research that would be responsible for strategic and structural planning of all agricultural research. Further, the team recommends the development of a unified National Institute for Agricultural and Livestock Research to fully integrate available resources in comprehensive research programs and otherwise implement the research efforts defined by the council. Such actions will need to involve the ministries of livestock, forestry and range, agriculture, higher education, planning, and finance.

6.6 Research Manpower Development

The rate of development of Somalia's agricultural research capacity is likely to be limited by the supply of adequately trained research staff and supporting personnel. Many of Somalia's scientists have only a first degree, which in most cases does not prepare a person for a productive career in agricultural research. Training in research methodology is necessary, after acquisition of basic scientific knowledge at the first-degree level. The present staff needs to be trained, some to the M.Sc. and some to the Ph.D.; within a few years, an M.Sc. should be required for entry into the research system as a research officer.

> The team recommends that the need for appropriately trained personnel be a usual consideration as priority research programs are planned, and that a concerted and sustained effort be made to supply the needed training -- as part of a comprehensive research staff training program -- until M.Sc. qualification can be required for entry into the research service as a research officer. While training needs should be controlled by specific research program plans, a reasonable goal would be to have about 200 M.Sc. and Ph.D. researchers in 15 years

Many of the present staff will have to be trained outside Somalia; most seeking the Ph.D. will have to be trained outside for many years. However, there is sufficient demand for M.Sc.-holders in some disciplines to warrant developing that training capability within Somalia.

> The team recommends that the university, in cooperation with the two ministries, decide which M.Sc.-degree programs will be developed first within the two faculties, and design a training program to facilitate their development. This training would have first priority within the broader training program to upgrade the usual competence of Somali research officers to the M.Sc.

6.7 Scheme of Service for Research Personnel

Productive research scientists need to be trained for their work, have the essential resources, and be motivated to do their work well. Imagination and initiative are especially important attributes. The work environment, especially leadership can do much to motivate researchers, but opportunity for reward and advancement in a career are also essential. The present personnel management system does not sufficiently reward scientific excellence. Research scientists need to work in an environment that encourages them to be observant, imaginative, have initiative, be productive, and stay in Somalia.

> The team recommends that Somalia implement a management system for its agricultural research personnel that motivates well-trained researchers to be productive and stay in Somalia. Such personnel management procedures are likely to include position descriptions, minimum qualifications, and specified tasks; periodic evaluation procedures; stated criteria and methods for selection for promotion to higher grades; grades or ranks having progressively higher pay that provide a career structure; and increments within grades or ranks that allow periodic rewards for service, with criteria for granting them.

The summary of actions indicated above form the major elements in a strategy to develop a research system to serve Somalia's agriculture. These need to be accompanied by a series of actions, most of which will be recurrent.

* The new National Council for Agricultural and Livestock Research will need to develop a set of criteria to be used to set research priorities and make an approximate allocation of resources to the major sectors.

* The new National Institute for Agricultural and Livestock Research will need to develop a set of research priorities (including programs within and among MLFR, MOA, and the university), make an approximate allocation of resources to each major research program area, and name the research leaders who have first responsibility for program formulation.

* The research leaders will need to define research programs in terms of context, rationale, objectives, methodologies, resources needed, and evaluation criteria. The scope of these programs will be limited by available resources, especially technical and managerial personnel. All research scientists who will be responsible for implementing the program should be involved in planning it. Programs should be reviewed and replanned annually.

* As research programs are planned, the need for basic resources at several research sites will be identified. Research managers can then compile these needs into a plan to develop units with essential facilities for doing routine research.

ANNEX 1

Brief Biodata of ISNAR Team Members

Dr. Matthew Dagg was trained in physics at Manchester University in the United Kingdom. After a short time at Rothamsted Experiment Station, he served as a research officer in the Physics Division of the East African Agriculture and Forestry Research Organization, Muguga, Kenya, from 1956-69. His research field was soil physics: soil, plant, water relationships; matching crops to environment; and catchment area research. He then served seven years as director of the Institute for Agricultural Research of Ahmadu Bello University, Nigeria, concentrating on research management. From 1977-81, he was a program officer with the Ford Foundation in New Delhi, India, and liaison scientist between IRRI and ICAR. He joined the International Service for National Agricultural Research (ISNAR) as a Senior Research Officer in June, 1981.

Dr. Zerubabel M. Nyiira is an agricultural entomologist. He was 23 years with the Ministry of Agriculture, Uganda, as a research officer, principal scientist, director of research, and chief research officer; he taught entomology and crop protection at the University of East Africa and Makerere University, Uganda. He served as a consultant to the OAU committee on food losses in Africa, as a member on the research appraisal board of the East African Natural Resources Research Council, and for 12 years was member and chairman of executive and technical committees of International Red Locust Organization for Southern Africa, Desert Locust Control Organization for Eastern Africa, and the International African Migratory Locusts Organization. He also headed a program of international cooperative research for three years before joining International Service for National Agricultural Research (ISNAR) as a Senior Research Fellow in September, 1981.

Dr. William R. Pritchard was reared on a livestock farm in the United States and received his advanced training in veterinary science and biochemistry. He has spent 37 years on the faculties of colleges of agriculture and schools of veterinary medicine in the U.S. His research and teaching has been directed toward the nutritional and metabolic disorders and infectious diseases of farm animals. He served for 10 years as associate director of the California Agricultural Experiment Station and 20 years as dean of the University of California School of Veterinary Medicine. He has had extensive experience with agricultural development projects throughout the world, largely under the sponsorship of the Rockefeller Foundation. He is currently professor of tropical veterinary medicine and international agriculture development at the University of California, Davis.

Dr. Floyd Williams, a plant pathologist by training, began his research career at the Ohio State University. He later taught and did research at the University of Maryland before joining an interdisciplinary regional research team in India. During the 1970s he worked with the agricultural research system in Pakistan for six years. A similar period was spent in Washington, D.C., as a research advisor for the U.S. Agency for International Development. This assignment brought substantial renewed contact with the U.S. land grant university system through the Joint Research Committee of the Board for International Food and Agricultural Development and with the international centers through the Consultative Group on International Agricultural Research. He joined the International Service for National Agricultural Research (ISNAR) in early 1982 as a Senior Research Officer.

ANNEX 2

Partial List of Persons Contacted

Ministry of Agriculture

Hon. Dr. Mohamed Abdi Nur	Vice-Minister of Agriculture
Mohamed Ali Abukar	General Manager, Agricultural Extension and Farm Management Project
Mohamed Warsama Duale	General Manager, Agricultural Development Bay Region
Abdurahim Haji Mohamed	Director, Planning Department
Hussein Haji Mohamed	General Manager, Settlement Development Agency (SDA)
Abdullahi Scek Ali	Director of Planning, SDA
Mohamed Abucar Haji	Director of Agriculture, SDA
Abdullahi Nur Alio	Director, Agricultural Research Institute
Mohamed Tahri Haji	General Manager, Strengthening Agricultural Production

Central Agricultural Research Station

Abdullai Sh. Omer Egeh	Cropping Systems and Agronomist
Ali Mohad Ahmed	Soil Chemist
Suleiman Daud Figi	Cowpea Breeder and Agronomist
Sekuja Cabolissekim	Sorghum Breeder
Nur Hagi Dere	Rice Breeder and Agronomist
Abdullahi Gune	Vegetable Breeder and Agronomist
Abukar Moallim	Entomologist, Faculty of Agriculture
A. Harabe	Director and Plant Pathologist
M. Isse	Plant Pathologist
Ahmed Hassan Mohamed	Pomologist
Bana Abanur Abukar	Maize Breeder and Agronomist
Mohamed Jusuf Shiil	Deputy Director

Jillib Regional Station

Abdulkadir Mohamed Abikar	Director

Bay Region Agricultural Development Project

John M. Halpin	Technical Manager
Ahmed Haji Abdalla	Regional Officer
Abdillahi Awed Farah	Agronomist
K.K. George	Veterinary Officer
Mohamed Warsama Duale	General Manager, Agricultural Development
Abdul Asis Mohomed Ali	Veterinary Officer
Abdullai Mohomed Barre	Veterinary Officer

Bay Region Extension Project (University of Wyoming Team)

Jerry Costel	Seed Farm Manager
Bernard Kelp	Agronomist

Bonka Research Station

Ado Aden Magan	Director
Yusuf Moalin Amin	Deputy Extension Officer

Bonka Agricultural Extension and Farm Management Project

Mohamed Awale Asayr	District Extension Officer
Yusuf Amin Quonsoh Deir	Extension Officer

Fanole Rice Project

Ahmed Haji Ali	Manager

FAO/UNDP Agricultural Research Project

J.S. Bakshi	Project Manager and Agronomist
Ahmed Moktarzadeh	Maize Breeder
A. Schuckler	Economist, Associate Expert
Iftikhar Ahmed	Farm Machinery, Associate Expert

International Development Research Centre

Roger Kirkby	Agronomist
Eugene Kevork Alahaydoyan	Sorghum Breeder

Ministry of Livestock, Forestry and Range

Hon. Dr. Mohamed Ali Noor	Minister of Livestock, Forestry and Range
Muctar A. Aban	General Manager, Romsoma
Ali Yousuf Ahmed	Director, Animal Health
Ahmed Aideed Mohamoud	Director, Animal Production
Ismael Alin	Director, Planning, Training and Research
Mohamud Haji Ibrahim	Assistant Director, Planning, Training and Research
Hussein Haji Abdullahi	Director, Serum and Vaccine Institute
Mohamoud Abdullahi	General Manager, Tsetse and Trypanosomiasis Control Project
Mohamoud Mohomed Wosughe	General Manager, Warmahun Dairy Farm
Jan de Neef and staff of the farm	Technical Advisor, FAO km-15 Poultry Farm
Abdi Mohamud Elmi	Veterinary Officer
Abdillahi X. Wayrax	Manager, Quoroley Dairy and Poultry Extension Farm

National Range Agency

Abdullahi Ahmed Karani	General Manager
Omar Addow	Director, Forestry Department
Bahaeldin Y.R.M.	Coordinator, Central Range Development Project
Mohamed A. Ayan	Director, Range and Environment Department
Tom Kelly	Planning Advisor, Forestry Department
Mohamed Musse Haji Aden	Director, Training and Planning.

Central Range Development Project

Yousef R.M. Bahaeldin	Project Coordinator
Hussein Khalif Mohamed	CRDP
Abshir Osman	CRDP Co Manager
Kay Wilkes	Louis Berger International Inc.
Floyd E. Kissinger	Louis Berger International Inc.
Michael Madany	Louis Berger International Inc.
S.H.A. Kazmi	Louis Berger International Inc.
Dennis Herlocker	Louis Berger International Inc.
David O. Frye	Louis Berger International Inc.

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Frank Prucella staff of the center	Technical Director

Serum and Vaccine Institute

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Lance Hayles	Team Leader, FAO/UNDP Project
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Mohyidiin	Veterinary Officer, Virology
Roskoshny	Veterinary Officer, Virology
Habiba Sheikh Hassan	Veterinary Officer, Bacteriology
Mursal	Laboratory Technician
A. Daar Warsama	Veterinary Officer, Parasitology
Mohamoud Abdulah Abdulai	Veterinary Officer, Parasitology
Hawa Guled	Veterinary Officer, Parasitology
Fatuma Mohamed	Veterinary Officer, Pathology
Ahmed Ali	Veterinary Officer, Pathology

School of Veterinary Medicine and Animal Science

Abdi Mohammod Mohamoud	Director, School of Veterinary Medicine
Abdul Razzaque	Head of the Curriculum

Veterinary Laboratory, Kismayo

Hussein Ismail Guled and staff of the laboratory	Director

Ministry of Labor

M. O. Jawari	Director General

Faculty of Agriculture, University of Somalia

A.H. Shirwa	Dean
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Mohamed Isse Mohamoud	Plant Pathologist
Abukar Moallim Mohamed	Entomologist
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Ahmed Nur Jama	Plant Pathologist
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Abdulhamid Hagi	Head, Department of Pathology
Ibrahim Ahmed Muse	Head, Department of Anatomy
Mohamed Ahmed Sh. Musse	Department of Animal Production
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O.H. Abdirizak	Dean

Ministry of Finance

M.M. Nur	Director-General

National Academy of Science and Arts.

Ahmed Artan Hange	Dean, Institute of Arts and Literature

World Bank:

Andrew Hayman	Resident Officer

UNDP

Robert Borthwick	Resident Representative

Food and Agriculture Organization

L. Hayles	Agricultural Resident Representative, acting
Jan de Neef	Technical Adviser, km-15 Poultry Project

United States Agency for International Development

Gerard Neptune	Chief, Agricultural Development
Flynn Fuller	Training Officer
Ken Randolph	Livestock Officer
Pam Prucella	Animal Health Officer

National Banana Board

Adam Abdi Aden	General Manager

Agricultural Development Corporation

Mahir Macalim Ibrahim	Planning Section
Yuusuf Max'd Digow	Grain Marketing Section

Agricultural Secondary School, Afgoi

Ahmed Cali Colbaye	Principal

Ministry of Planning

Mr. Narayan	Irrigation Advisor

Water Development Agency

M. von Hoyer	G.T.Z. Technical Advizor

Tsetse and Trypanosomiasis Control Project, Mogadishu Laboratory, Afgoi

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Mohamed Farah Dirie	Veterinary Officer, Protozology
Omar Ali	Entomologist
Mohamed Ali	Diagnostic Veterinarian
Dr. Gledhill	Technical Advisor

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Dean Emeritus Larry Smith	Director, University of Somalia-University of Saskatoon Project

National Extension Service, Ministry of Agriculture

Mohamed Ali Abukar	General Manager
Gordon Beckstrand	Team Leader, FMETC Project, Utah team
Paul Daniels	Agronomist, Utah team.

ANNEX 3

Statistics on Somalia

The following tables were taken or derived from (as indicated): Ministry of National Planning, Somalia Democratic Republic. 1982. Five year development plan, 1982-1986. Mogadishu.

EXPORT RECEIPTS 1978-80
(In millions of Somali shillings at current prices.)

	1978	1979	1980
Live animals	570.4	474.1	639.5
Bananas	59.0	73.2	51.2
Meat and meat preparations	0.7	7.3	6.5
Fish and fish preparations	4.3	2.7	1.6
Hides and skins	29.7	56.4	41.8
Fuel oil	-	16.0	61.0
Myrrh, incense	14.8	21.0	21.9
Other exports	10.2	16.7	15.8
TOTAL	689.1	667.4	839.3

Source: Five Year Development Plan, p.289.

IMPORTS BY MAIN GROUPS OF COMMODITIES*
(In millions of Somali shillings at current prices.)

	1978	1979
Consumer goods	677.6	523.6
Foodstuffs	(250.5)	(222.8)
Intermediate goods	62.0	158.9
Petroleum products	92.4	84.7
Building materials	68.0	145.6
Machinery and equipment	224.0	204.3
Transport equipment	315.1	304.4
Other imports	79.8	124.3
TOTAL	1,518.9	1,545.8

*Based on foreign trade returns. These figures differ from the exchange records provided by the Central Bank and relate only to regular imports.

Source: Five Year Development Plan, p.290.

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SOMALIA GROSS DOMESTIC PRODUCT
(Based on 1970 constant prices.)

	Source in 1978 percent	Growth Rate 1972-78 percent
Total	100	3.3
of which:		
Agriculture	51	1.7
Crop production	(10)	-2.9
Livestock	(33)	2.7
Forestry	(8)	4.3
Fisheries	-	1.4
Manufacturing	8	-0.8
Transport and Communications	6	1.3
Finance and insurance	9	12.9
Government services	12	8.9

Source: Derived from Five Year Development Plan, p.24.

GROSS DOMESTIC PRODUCT 1981
(In millions of Somali shillings at 1980 prices.)

		Percentage of GDP at factor cost
Agriculture	7,239	49.5
Crop production	(819)	(5.6)
Livestock	(5,797)	(39.7)
Fisheries	(129)	-
Forestry	(494)	(3.3)
Mining	67	-
Manufacturing	1,162	8.0
Electricity and water	91	-
Construction	582	4.0
Transport and communications	1,641	11.2
Trade, hotels, and restaurants	825	5.6
Finance and insurance	1,042	7.1
Government services	1,609	11.0
Other services	357	2.4
GDP at factor cost	14,615	100.0
Indirect taxes net of subsidies	2,409	
GDP at market prices	17,024	

Source: Derived from Five Year Development Plan, p.53.

EXPENDITURES 1974-79
(In millions of Somali shillings at 1980 prices.)

		Percentage of Total	Percentage of Agriculture
Total	5,677	-	-
of which:			
Agriculture	1,251	22	100
Livestock and Forestry	(293)	5	23
Crops	(809)	14	65
Fisheries	(149)	3	12

Source: Derived from Five Year Development Plan, p.36.

PLANNED CAPITAL INVESTMENT 1982-86
(In millions of Somali shillings at 1980 prices.)

		Percentage of Total	Percentage of Agriculture
Total	16,298	-	-
of which:			
Agriculture	7,693	44	100
Livestock	2,433	14	32
Crop production	811	5	11
Irrigation	3,932	22	51
Forestry	58	-	1
Fisheries	459	3	6

Source: Derived from Five Year Development Plan, p.48.

ANNEX 4

Somalia National Academy of Science and Arts

The Somalia National Academy of Science and Arts, established in 1978 by presidential decree, is an autonomous body under the guidance of the Ministry of Higher Education and Culture. The objectives of the academy are:

* to promote, support, and coordinate research undertaken by individuals and institutions;
* to upgrade research standards and research capabilities;
* to promote the application of research results in various sectors of development;
* to help develop scientific attitudes and values;
* to establish contact with similar institutions in other countries.

The academy has institutes for science and for arts and six departments -- language, fine arts, natural science, social science, documentation, and administration.

The staff of the academy includes some 30 university graduates. The president has a doctorate, one-third of the staff hold master's degrees, and two-thirds hold bachelor's degrees. Ten are assigned to the language department, 3 to natural sciences (of whom 2 are abroad on study), 13 to social sciences, 1 to documentation, and 2 to fine arts.

Much of the work of the academy is assisted through a series of projects, many financed by Sweden. Projects include an investigation on medicinal plants and their use in folk medicine; a description of traditional methods of animal disease control; camel husbandry; tomato improvement; and frankincense and myrrh cultivation. These are implemented by the appropriate units of the ministries of health, livestock and agriculture. The Department of Social Sciences has done some research in archaeology, on the traditional legal system, and on architecture. Three students from this department are studying social anthropology in London. The Department of Language is largely concerned with preserving the oral traditions of Somalia and with standardizing the Somali language; the academy seems to have taken responsibility for implementing research in languages and the social sciences. The documentation unit has a considerable backlog of materials for publication, awaiting their turn on the government press. They are developing a library at the academy and will market academy publications. The Department of Arts is not yet well developed, but it is intended to establish schools for art, dance, music, and theatre. It presently supports a folk dance group.

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The present budget of the academy is about Sh5 to 6 million (US$330,000 to US$400,000) per year, and a small part of that is available for internal research. The government of Somalia apparently supplies about Sh300,000 (US$20,000) per year, and the remainder of the budget is from projects developed by the academy with the assistance of donors.

To date, the academy has not concentrated its efforts on the development of a strong sense of a scientific community or otherwise promoted the use of science to serve Somalia's development needs. Within the academy, there is provision for a national research council. As conceived, it would be composed of many of Somalia's senior scientists and chaired by the president of the academy. Such a council would seem well suited to guide the government on the evolution of policies to make best use of science in Somalia's development.