



# AGRICULTURAL RESEARCH MASTER PLAN

Department of Agricultural Research  
Ministry of Agriculture and  
Livestock Development

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# AGRICULTURAL RESEARCH MASTER PLAN

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## FOREWORD

This second edition of the Master Plan, like the first edition, is a detailed document based on past and present research experiences. It analyses the strengths and weaknesses in the research system. It is, therefore, founded on realistic and flexible experiences. It contains a detailed five year plan and provides broad guidelines for the future. It is aimed at improving efficiency in the research system in order to meet national goals and objectives.

The Master Plan is a valuable document for researchers, research managers and policy makers who have vested interest in agriculture for improving research efficiency through better planning and implementation of research programmes and reporting of research results.

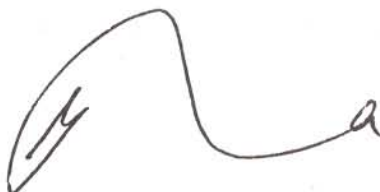
Research priorities have been determined according to national goals and research objectives for guiding policy makers in the allocation of funds to programmes of high priority. Proposals have also been outlined for strengthening the research management and administration, and for improving the career structure of the Department of Agricultural Research (DAR). Similar proposals have been made to restructure some of the commodity groups by creating additional commodity teams, and to establish essential laboratory facilities to cater for specialised research programmes. For ideas incorporated in the Master Plan to be effective, there is need to improve the linkages between policy makers, researchers, extension workers and farmers: particularly by obtaining financial commitment from policy makers regarding implementation of the proposals.

Much effort has been put into compiling, arranging and editing of this edition by Dr. Austin S. Kumwenda, Dr. Charles J. Matabwa, Dr. Andrew T. Daudi, Mr. Hastings N. Soko, Mr. Aggrey R.E. Mwenda, Mr. Felix W. Kisyombe, Dr. Wilson T. Gondwe, Mr. Austin W.C. Zimba and Dr. John D.T. Kumwenda. They took into account the contents of the first edition and the current government policy of poverty alleviation.

Recognition should be given to all DAR scientists, Programme Managers, and others who contributed to the development and production of the second edition of the Master Plan. Special thanks should go to Mrs. N. Chintsanya for her secretarial work.

Thanks should also go to the Overseas Development Administration (ODA) of the British Government for providing financial support for the preparation and production of this edition of the Research Master Plan.

It is hoped that this Master Plan of DAR will guide agricultural scientists and policy makers in the planning and execution of research programmes for the development of agriculture in Malawi.



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PRINCIPAL SECRETARY FOR AGRICULTURE AND LIVESTOCK DEVELOPMENT

## LIST OF ACRONYMS

|         |  |
|---------|--|
| ACARO   | Assistant Chief Agricultural Research Officer                      |
| ACB     | Agricultural Communications Branch                                 |
| ADARTS  | Assistant Director of Agricultural Research and Technical Services |
| ADB     | African Development Bank   |
| ADD     | Agricultural Development Division                                  |
| ADDFOOD | Agricultural Development Division Food Production Project          |
| ADMARC  | Agricultural Development and Marketing Corporation                 |
| AGREDAT | Agricultural Economics, Statistics and Data Processing             |
| AGRIMAL | Agricultural Implements of Malawi                                  |
| AGRIS   | Agricultural Information Data Base                                 |
| AO      | Administrative Officer   |
| ARC     | Agricultural Research Council                                      |
| ARDF    | Agricultural Research and Development Fund                         |
| ARET    | Agricultural Research and Extension Trust                          |
| ARO     | Agricultural Research Officer                                      |
| ART     | Adaptive Research Team   |
| ARS     | Agricultural Research Scientist                                    |
| AS      | Agricultural Scientist   |
| ASC     | Agricultural Sciences Committee                                    |
| ASP     | Agricultural Services Project                                      |
| AssC.Sc | Assistant Chief Scientist  |
| ATC     | Agricultural Trading Company                                       |
| ATCC    | Agricultural Technology Clearing Committee                         |
| AVRDC   | Asian Vegetable Research and Development Centre                    |
| BNF     | Biological Nitrogen Fixation                                       |
| B.Sc    | Bachelor of Science  |
| CAETO   | Chief Agricultural Extension and Training Officer                  |
| CARO    | Chief Agricultural Research Officer                                |
| CARP    | Controller of Agricultural Research Programmes                     |
| CARTS   | Controller of Agricultural Research and Technological Services     |
| CARS    | Controller of Agricultural Research Services                       |
| CAS     | Controller of Agricultural Services                                |
| CATRS   | Controller of Agricultural Technological Research Services         |
| CCC     | Chitedze Composite C   |
| CCD     | Chitedze Composite D   |
| CEO     | Chief Executive Officer  |
| CGIAR   | Consultative Group of International Agricultural Research          |
| CIAT    | International Centre for Tropical Agriculture                      |
| CIMMYT  | Maize and Wheat Improvement Centre                                 |
| CPO     | Chief Personnel Officer  |
| CPLO    | Chief Planning Officer   |
| CRT     | Commodity Research Team  |
| CSc     | Chief Scientist  |
| CSC     | Christian Service Committee  |
| CTL     | Commodity Team Leader  |
| CTO     | Chief Technical Officer  |
| CVO     | Chief Veterinary Officer   |
| DAET    | Department of Agricultural Extension and Training                  |
| DAHI    | Department of Animal Health and Industry                           |
| DARTS   | Director of Agricultural Research and Technical Services           |
| DAR     | Department of Agricultural Research                                |
| DDARTS  | Deputy Director of Agricultural Research and Technical Services    |
| DCARO   | Deputy Chief Agricultural Research Officer                         |
| DCARS   | Deputy Controller of Agricultural Research Services                |
| DCSc    | Deputy Chief Scientist   |
| DVO     | Divisional Veterinary Officer                                      |
| DWASCO  | Dwangwa Sugar Corporation of Malawi                                |
| EEC     | European Economic Commission                                       |
| EU      | European Union   |
| FAO     | Food and Agriculture Organisation of the United Nations            |
| FRIM    | Forestry Research Institute of Malawi                              |
| GDP     | Gross Domestic Product   |
| GoM     | Government of Malawi   |
| GNP     | Gross National Product   |
| GOT     | Ginning Outturn  |
| GTZ     | Germany Agency for Technical Development                           |
| IARC    | International Agricultural Research Centres                        |
| ICARDA  | International Centre for Agricultural Research in Dry Areas        |
| ICI     | Imperial Chemical Industries                                       |
| ICRAF   | International Council for Research on Agroforestry                 |
| ICRISAT | International Crop Research Institute for Semi Arid Tropics        |
| IDA     | International Development Agency                                   |
| IITA    | International Institute for Tropical Agriculture                   |

|         |   |
|---------|---|
| ILCA    | International Livestock Centre for Africa   |
| ILRAD   | International Livestock Research on Animal Diseases                                   |
| ILRI    | International Livestock Research Institute  |
| IPM     | Integrated Pest Management  |
| IRRI    | International Rice Research Institute   |
| ISNAR   | International Services for National Agricultural Research                             |
| KARI    | Kenya Agricultural Research Institute   |
| KFCTA   | Kasungu Flue Cured Tobacco Authority  |
| MAEPS   | Malawi Agricultural Extension and Planning Support Project                            |
| MARE    | Malawi Agricultural Research and Extension Project                                    |
| ME      | Monitoring and Evaluation   |
| MEPC    | Malawi Export Promotion Council   |
| MK      | Malawi Kwacha   |
| MH      | Malawi Hybrid   |
| MOALD   | Ministry of Agriculture and Livestock Development                                     |
| MOREA   | Ministry of Research and Environmental Affairs  |
| M.Sc.   | Master of Science   |
| MPGRC   | Malawi Plant Genetic Resources Centre   |
| NARP    | National Agricultural Research Project  |
| NARS    | National Agricultural Research System   |
| NGO     | Non-governmental Organisation   |
| NRC     | National Research Co-ordinator, DAR   |
| NRC     | Natural Resources College   |
| NRDP    | National Rural Development Project  |
| NSCM    | National Seed Company of Malawi   |
| NTSC    | National Technical Services Co-ordinator  |
| OAU     | Organisation of African Unity   |
| ODA     | Overseas Development Agency of British Government                                     |
| OGL     | Other Grain Legumes   |
| PA      | Principal Accountant  |
| PAO     | Principal Administrative Officer  |
| PARO    | Principal Agricultural Research officer   |
| PAS     | Principal Agricultural Scientist  |
| PERM    | Participatory Extension and Research Method   |
| PIB     | Professional Interviewing Board   |
| Ph.D    | Doctor of Philosophy  |
| PM      | Programme Manager   |
| PO      | Professional Officer  |
| POSAM   | Pesticide Suppliers Association of Malawi   |
| PSc     | Principal Scientist   |
| PU      | Planning Unit   |
| R & D   | Research and Development  |
| RDP     | Rural Development Project   |
| RP      | Research Programmes   |
| SACA    | Smallholder Agricultural Credit Administration  |
| SACCAR  | Southern African Centre for Cooperation in Agricultural Research                      |
| SADC    | Southern Africa Development Community   |
| SARCCUS | Southern African Regional Commission for the Conservation and Utilisation of the Soil |
| SARMEIT | South African Regional Maize Evaluation and Improvement Trial                         |
| SARO    | Senior Agricultural Research Officer  |
| SAS     | Senior Agricultural Scientist   |
| SCA     | Smallholder Coffee Authority  |
| Sc      | Scientist   |
| SEO     | Senior Executive Officer  |
| SSA     | Smallholder Sugar Authority   |
| STA     | Smallholder Tea Authority   |
| STA     | Senior Technical Assistant - DAR  |
| STO     | Senior Technical Officer  |
| SS      | Supporting Staff  |
| S.Sc    | Senior Scientist  |
| SUCOMA  | Sugar Corporation of Malawi   |
| TA      | Technical Assistant   |
| TCH     | Technology Clearing House   |
| TNA     | Tree Nut Authority  |
| TO      | Technical Officer   |
| TRF     | Tea Research Foundation   |
| TRIM    | Tobacco Research Institute of Malawi  |
| TSA     | Technical Services and Administration   |
| TT      | Technology Transfer   |
| UNDP    | United Nations Development Programme  |
| US      | Under Secretary   |
| USAID   | United States Agency for International Development                                    |
| WVI     | World Vision International  |



## EXECUTIVE SUMMARY

The main purpose of producing the Master Plan of the Department of Agricultural Research is to provide an appropriate framework or strategy to make future research work more effective in achieving the national goal of increasing agricultural production. It reflects the opinion of the Malawi scientists, the Ministry of Agriculture and Livestock Development and members of the Agricultural Research Council. The Master Plan is a dynamic document of research activities which requires continuous reviewing and updating.

Several factors affecting research have been discussed. The following summary contains conclusions and recommendations to improve the overall performance of the Department of Agricultural Research (DAR).

An exercise was carried out to prioritise commodities into four ranks according to national and Agricultural Development Division (ADD) importance. Based on this exercise, guidelines have been drawn up for allocating funds to DAR's commodity teams. The most important elements considered were research and technical factors and constraints, appropriateness of the proposed research programmes and the importance attached to the commodity. Government funding and effort should, therefore, concentrate on commodities with high priority, while reducing or cutting activities in commodities of low priority. It was difficult to prioritise technical services but government should provide adequate funds to enable them operate efficiently given their overall importance as support services. It has been proposed that research funding should be increased from the present 0.5% of the Agricultural Gross Domestic Product (GDP) to over 1.0%.

Management of DAR at headquarters should be strengthened. The Chief Agricultural Research Officer and his two deputies are overloaded with work and many programmes lag behind because of attending to national and international commitments. It has been proposed that the position of the Deputy Chief Agricultural Research Officer responsible for Technology Transfer be created.

The current career structure of the DAR does not provide adequate incentives for its staff. Therefore, it is proposed that some of the existing posts should be upgraded and new ones created to allow scientists to advance within their areas of specialisation, without having to go into administrative posts. This could be done by upgrading and broadening the super scale posts and by establishing additional senior positions for support staff. To enhance the implementation of these, training of professional, technical, clerical and accounting staff should be intensified. Officers returning from MSc and Ph.D training should be graded appropriately to reflect their training, skills and experience. Many experienced scientists are frustrated because they are not as rapidly promoted as their colleagues in the other departments within the same Ministry of Agriculture and Livestock Development.

Many scientists are in their mid or late forties. Policy makers should start thinking seriously about replacement programmes. This should be accorded high priority in the light of the high attrition rate the DAR is experiencing presently. In addition, some scientists are single-handed in their areas of specialisation (discipline). To address these issues, proposals for recruiting additional staff are made. Manpower development and recruitment should be taken as an integral part of improving the capabilities of the Department of Agricultural Research.

Some research commodity teams, which are presently too broad, should be re-organised to allow sufficient coverage of all important research areas. The major commodity groups to be re-organised are the horticulture, livestock and pastures, and Agricultural Technical Services groups. Proposals have also been made for the establishment of specialised laboratories to cater for specific research programmes.

In order to improve the research efficiency and farmer's adoption of new technologies, linkages between policy makers, research scientists, extension workers, farmers and industry should be improved. To ensure adequate funding for research and extension programmes, researchers and extension workers should be able to convince policy makers of the importance of their programmes and activities in meeting national objectives. To this end, it is proposed that researchers and extension workers should regularly, and timely, submit annual reports of their completed programmes, work programmes and budgets to policy makers. Farmers' socio-economic circumstances should be considered by both extension workers and researchers so that research programmes effectively address farmers' real problems. To achieve this, it is suggested that both researchers and extension workers should involve farmers in problem identification, planning and execution of on-farm trials using the Participatory Extension and Research Method (PERM) approach. Agricultural pricing policies should provide incentives for farmers to increase production and improve their incomes. Such policies should be supported by essential infrastructure such as effective marketing and credit systems.

The Agricultural Research Council has been re-organised to include some members and chairmanship from outside the Ministry of Agriculture and Livestock Development to strengthen its activities. Budget estimates from different commodity teams' action plans should be reviewed taking into account donor funding and priorities. In addition, it is proposed that the council should provide budget ceilings to the scientists prior to annual research project meetings for proper programme planning. Research priorities and proposals should be determined according to national goals and objectives as spelt out in the Statement of Development Policies of 1987/96 considering the available human, financial and physical resources. Funds should be allocated to ensure that all the research programmes approved by the Agricultural Research Council are implemented.

Most of the proposals in the first edition of the Master Plan were not implemented either because of lack of funds or there was no initiative. It is envisaged that the current proposals, if implemented, will make future research activities more effective in meeting the desired goals of generating appropriate environment and technologies for increasing agricultural production and productivity, especially for the smallholder farmers.

## CHAPTER 1

### INTRODUCTION

#### 1.1 BACKGROUND INFORMATION

Malawi is basically an agricultural country located in South-East Africa surrounded by Tanzania, Mozambique and Zambia. It is a long and narrow country that extends from 9° 45' to 17° 5' south of the Equator for about 900 km in length from north to south and varying in width from 80 to 160 km. The total area is 12.3 million ha of which 2.9 million ha is under water.

The fact that Malawi is a land-locked country presents a major communication problem. The closest routes to the Indian Ocean are two railway lines to Mozambique: one of 360 km from the Southern border to the port of Beira, another of 615 km from the Eastern border to the port of Nacala. Alternative ways are through Dar-es-Salaam in Tanzania (Northern Corridor) and Durban via Zambia and Zimbabwe with 2,500 km and 3,500 km, respectively. Therefore, transport cost is a heavy burden on the country's economy.

Malawi's population was estimated at about 10 million by mid 1994 with an average growth rate of 3.3% per year and with an average population density of 83 persons per square kilometre, making Malawi one of the most densely-populated countries in sub-saharan Africa. An estimated 46% of the population is under 15 years of age and about 88.9% of the total population lives in rural areas. The distribution of the Malawi population is shown in Table 1.1.

Table 1.1: Population Distribution in Malawi

| REGIONS  | URBAN   |       | RURAL   |       | TOTAL   |       |
|----------|---------|-------|---------|-------|---------|-------|
|          | ('000)  | %     | ('000)  | %     | ('000)  | %     |
|          | TOTAL   | TOTAL | TOTAL   |       |         |       |
| NORTHERN | 135.5   | 1.38  | 1,009.6 | 10.27 | 1145.1  | 11.65 |
| CENTRAL  | 313.8   | 3.19  | 3,393.2 | 34.51 | 3707.0  | 37.70 |
| SOUTHERN | 644.5   | 6.55  | 4,336.0 | 44.10 | 4980.5  | 50.65 |
| NATIONAL | 1,093.8 | 11.12 | 8,738.8 | 88.88 | 9,832.6 | 100   |

Source: National Statistical Office Projected Population as at Mid 1994, Zomba, Malawi.

#### 1.2 IMPORTANCE OF AGRICULTURE

Crops and livestock (agriculture) contribute about 33% of the Gross Domestic Product (GDP) and account for 90% of the foreign exchange (OPC, 1992). Three main cash crops: tobacco, sugar and tea, account for about 80% of the total exports. Maize, as the staple food, is the most important crop to the Malawian population and occupies 68% of the land for crops. Surpluses of maize have been produced in favourable seasons but, in recent years, production has fluctuated due to unattractive input and producer price relationships and unfavourable weather conditions.

Over 70% of the cultivated area in Malawi is under the customary land tenure system and is utilised by 1.2 million smallholder farm families with holdings ranging from 0.5 to 2.5 ha. Smallholder farmers produce numerous crops such as tobacco, maize, groundnuts, pulses, sweet potatoes, cassava, sorghum, rice, potatoes, sunflower, wheat, vegetables, fruits, coffee, macadamia, cashew and spices, and livestock such as cattle, sheep, poultry, goats, rabbits and pigs.

The estate sector utilises approximately 5% of the cultivated area on 1,300 units under the leasehold and free hold tenure systems. This sector primarily produces burley and flue-cured tobacco, sugar, coffee, tea and tree nuts. Together, crops and livestock contribute about 80% of the total agricultural production.

In 1980, there were 3.45 million ha of arable land under cultivation, out of which 0.47 million ha were cultivated by the estate sector and 2.88 million ha by smallholder farmers. The remaining available land for cultivation was 0.10 million ha (2.8%) showing that there is little room for increasing cultivated area. Thus, any future increases in agricultural production will have to come from improving crop and livestock yields per unit area instead of increasing land under cultivation. This will call for applying modern technology, developed through research, to promote increased yields by farmers.

#### 1.3 AGRICULTURAL POTENTIAL

Malawi has a large variety of soil types and topography. The climatic conditions throughout the year form two distinct seasons: the rainy season from November to April, and dry season from May to October. Rainfall is fairly reliable and unevenly distributed during the season, with a range of 700 to 1500 mm. There are three main agro-climatic zones: the plateau areas, the lakeshore and the Shire Valley each of which has different climatic conditions due to differences in altitude. The large variations in climate provide high potential for the production of a wide range of crops. This also presents more complications and challenges for agricultural research in developing appropriate technologies.

There is large scope for increasing the livestock population and quality in the country. Livestock accounts for about 7% of the agricultural GDP in Malawi. In 1990, per capita consumption of animal protein was estimated at 6.3 kg per annum, considerably less than the 12.5 kg average for Africa. The current animal population estimates are relatively low with cattle at about 807,600. Goats are about 898,700; sheep, 108,800 and pigs are estimated at 254,400 and from about 10-14 million chickens (Agriculture and Livestock Development Strategy and Action Plan, 1994). An

increase in livestock numbers would make meat, milk and milk products more accessible for domestic consumption, bringing a considerable improvement in the diet of the population and encouraging mixed farming for better utilisation of land resources. Cattle should also be utilised more widely for draught power for land preparation, weeding and transport.

There is potential for expanding production of horticultural crops to improve the diets and cash incomes of the people; increase exports of fruits, macadamia and cashew nuts, vegetables and spices to supply the European market during the winter season, and reduce imports of fresh and processed horticultural products. There is also potential for expanding some of the neglected crops such as cowpeas, groundbeans, sesame, jute, perfume-extraction plants, vanilla and garlic, among others, both for home and export markets.

Since independence, Malawi has made significant improvements in increasing food crop production, largely due to the expansion of area under cultivation instead of increasing yields of crops per unit area of land. The national average yields of major crops are still far below those obtained by research (Table 1.2). There is a 44 - 82% gap in yields per unit area between research stations and those obtained by farmers.

There is a large potential for increasing yields through utilisation of improved technologies from research, such as high-yielding varieties and improved agronomic practices. This calls for a systematic effort to disseminate appropriate technologies.

If maize yields per unit area can increase, agricultural diversification will be easier on the land released from maize. This way, the incomes and traditional diet of the population would be improved by introducing different types of crops and livestock.

Malawi has a great potential also for developing irrigation to further improve agricultural production. Both estate and smallholder production of high-value crops would benefit from supplementary irrigation during the rainy season and full irrigation during the dry season. In this way, both land and labour would effectively be used. Various low-cost irrigation schemes based on the intensive utilisation of hand labour and free energy equipment, such as water harvesting, gravity-fed irrigation, river water current and wind power pumps would effectively contribute to increased production per unit area of land.

Table 1.2: Area Planted and Yields of Some Food and Cash Crops

|                  | Area<br>Planted<br>(000 ha) | Average<br>Yields<br>(t ha <sup>-1</sup> ) | Research<br>Yield<br>(t ha <sup>-1</sup> ) | Percent<br>Yield<br>Gap* |
|------------------|-----------------------------|--|--|--------------------------|
| Maize            | 1,391.9                     | 1.73***                                    | 8.00                                       | 78.38                    |
| Pulses           | 199.0                       | 0.40                                       | 2.00                                       | 80.00                    |
| Cotton           | 58.7                        | 0.73                                       | 2.00                                       | 63.50                    |
| Rice             | 32.8                        | 2.22                                       | 4.50                                       | 50.67                    |
| Sorghum & Millet | 46.0                        | 0.56                                       | 2.50                                       | 77.60                    |
| Cassava          | 71.6                        | 2.34                                       | 13.00                                      | 82.00                    |
| Wheat            | 1.5                         | 0.59                                       | 1.50                                       | 60.67                    |
| Sunflower        | 8.0                         | 0.56                                       | 2.50                                       | 77.60                    |
| Potatoes**       | 5.6                         | 7.18                                       | 13.80                                      | 47.97                    |
| Tobacco          | 3.4                         | 0.66                                       | 2.00                                       | 67.00                    |
| Groundnuts       | 70.0                        | 0.44                                       | 2.00                                       | 78.00                    |
| TOTAL            | 1,888.5                     | -  | -  | -                        |

\* Percent Yield Gap is the relationship between national average yields by farmers and maximum yields obtained by research.

\*\* Yield on dry weight basis.

\*\*\* The average maize yield combines average production of three different types of maize. These are local, composites and hybrids. Otherwise these varieties produce on average at the following levels: local, 1 t ha<sup>-1</sup>; composites 2-3 t ha<sup>-1</sup> and hybrids 3-4 t ha<sup>-1</sup>.

#### 1.4 AGRICULTURE POLICY

The overall government policy is to improve the well-being of Malawians through poverty alleviation, especially among rural people, by promoting broad-based and rapid agricultural development. This is stated in the Statement of Development Policies 1987-1996 and in the Agricultural and Livestock Development Strategy and Action Plan (1994).

As part of the overall aim of rural poverty alleviation, other objectives of Malawi's agriculture and livestock development include:

- improving food self-sufficiency and the nutritional status of the population.
- encouraging self-reliance through increased broad-based small scale agro-industries and businesses.
- expanding and diversifying crops' and livestock products' exports.
- raising farm incomes and promoting economic growth while conserving natural resources.

These policy objectives will be achieved by minimising:

- the deterioration of natural resources.
- the serious disproportionate distribution of crops and livestock incomes.
- the over-dependence on volatile external trade flows.

## 1.5 AGRICULTURAL RESEARCH

### 1.5.1 The Past, Present, Achievements to date and Future of Agricultural Research

*Missu*

The overall objective of agricultural research in Malawi is to plan and conduct applied or production-oriented research that will generate information and technologies which can be directly utilised by estate and smallholder farmers to solve their technical production problems. Agricultural research should assist in poverty alleviation by providing information and technologies that would minimise production risks and the deterioration of natural resources; reduce over-dependence on a few food and cash crops leading to stable and sustainable yields.

#### 1.5.1.1. The Past

Prior to 1985, research was organised on a project basis, by crop, livestock or discipline. The funds were allocated to the research stations and officers-in-charge distributed them to each project. The infrastructure was very expensive to run, resulting in more than 60% of the funds being spent on administrative costs, leaving little for actual research.

In 1985, research projects in the Department of Agricultural Research (DAR) were re-organised as a result of the National Agricultural Research Project (NARP) which was financed by the International Development Agency (IDA) of the World Bank. This was done by:

- improving the planning, implementation, co-ordination and monitoring of research programmes,
- improving research facilities through the provision of office space, laboratories, library, staff housing, laboratory and field equipment, transportation, training and funding of specific research programmes,
- re-organising research programmes into multidisciplinary commodity groups rather than research projects,
- creating Adaptive Research Teams (ARTs) to serve as a link between research and extension.

To further strengthen agricultural research, an Agricultural Research Council (ARC) was created in November, 1985. This is a high level policy body on research priorities. Its mandate was, and still is, to formulate research policies and priorities for DAR and advise the Ministry of Agriculture and Livestock Development on financial and human resource needs of the Department. In addition, the ARC secretariat has a specific function of preparing, periodically, and reviewing the Agricultural Research Master Plan. The composition of the council has been revised to 16 selected members and chaired by an elected Chairman from amongst the members. The vice-Chairman is also elected by the members' popular vote. Other members are heads of department, institutions and private sector related to crops and livestock research, and two distinguished scientists. The secretary of the ARC is the Chief Agricultural Research Officer.

#### 1.5.1.2. The Present

The Department of Agricultural Research carries out most of the crops and livestock research work in the country. The emphasis of DAR's research is on smallholder farmers rather than on estate farmers. Other research work, especially on high-value crops such as tea, tobacco and sugarcane, is conducted by the Tea Research Foundation (TRF), the Agricultural Research and Extension Trust (ARET) and the Sugar Corporation of Malawi (SUCOMA), respectively. The University of Malawi carries out research on various disciplines and commodities: Bunda College of Agriculture carries out research on indigenous vegetables, rabbits, pigs, goats, farm machinery, socio-economic studies and some work on beans. Chancellor College works together with DAR on research on cassava pests, soil pests, cassava processing and income surveys in tobacco growing areas of the country. The Department of Animal Health and Industry (DAHI) carries out research on animal diseases. Contract research is sometimes awarded by DAR to other research organisations to utilise research capabilities available in the other national agricultural research systems (NARS).

DAR conducts research using a network of 3 main research stations, 5 experimental stations and 9 sub-stations. Research programmes are organised into 7 commodity groups each one headed by a National Research Co-ordinator (NRC), and within each commodity group there are multidisciplinary commodity teams each one headed by a Commodity Team Leader (CTL). Research funds are now allocated to NRCs whilst the Officers-in-Charge are allocated with funds for station administration. But the accountable officer is the Officer in-Charge.

#### 1.5.1.3 Research Achievements to Date

A number of achievements have been realised by the commodity teams over the years. New agronomic and management recommendations for crops and livestock have been developed together with the release of improved crop varieties and breeds of livestock. A total of 160 varieties of 73 different crops are currently under cultivation together with 12 breeds of livestock from four species. A selected number of research achievements in some commodity groups/teams are mentioned in the following sub-sections.

##### (a) Soils and Agricultural Engineering

The Soils and Agricultural Engineering commodity group is comprised of the Agro-forestry, Farm Machinery, Irrigation and Drainage, Soil Survey, Soil Microbiology and Soil Fertility commodity teams. The achievements of these commodity teams are described below:

##### (i) Soil Fertility Commodity Team:

While germplasm development is important, progress towards increased productivity requires

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complementary advances in soil husbandry and management. With this in mind, the commodity team initiated several research programmes which have resulted in the following achievements:

- site-specific fertiliser recommendations for crops, based on soil analysis,
- use of fertilisers by majority of smallholder farmers as a result of various agronomic, chemical and physical research on soils.
- disrecommendation of the use of acidifying fertilisers on latosols (upland soils).
- development of cultivation methods that conserve soil-water at the beginning of the season and allow the disposal of excess soil-water later in the season.
- development of soil phosphorous, potassium and sulphur indexes.
- establishment of critical levels for the various nutrients through correlation and calibration studies by the commodity team.

(ii) **Soil Microbiology**

Production of inoculum for use in Soya bean production.

(iii) **Soil Survey:**

The Soil Survey commodity team has produced soil maps and reports required for either the implementation or extension of the following projects:

- (a) Dwangwa Sugar Corporation (DWASCO)
- (b) The Sugar Corporation of Malawi (SUCOMA).
- (c) Smallholder Coffee Authority (SCA).
- (d) Tobacco Research Institute of Malawi (now ARET) Projects.
- (e) Other achievements include:

- a soil map for the land under Bunda College of Agriculture which is used for teaching and research purposes.
- a general map for the whole of the Salima Agricultural Development Division area which is being used for planning and other purposes.
- soil maps for selected areas for other Agricultural Development Divisions.
- soil maps for consulting firms such as Hunting Technical Services.
- detailed soil maps and reports for Chitedze research station and the sub-stations of Meru and Mbawa.
- a soil map of Malawi on a scale of 1:1,000,000.

(iv) **Irrigation and Drainage Commodity Team:**

Research carried out by the Commodity team has resulted in:

- sensitisation of policy makers about the potential for double cropping system in one calendar year.
- realisation of the potential for the production of horticultural and sugarcane crops under irrigation.
- fertiliser recommendations for maize and cotton under supplementary irrigation.
- development of water use, irrigation frequency and fertilisation packages for different crops.

(v) **The Farm Machinery Commodity Team:**

The commodity team has, over the years, tested, modified and recommended some farm implements that are appropriate to Malawi's conditions. These include crop sprayers from various countries for controlling pests; grain dehullers for removing husks from maize grains and other cereals; hand implements and hoes; various types of animal-drawn ridgers, ploughs, cultivators and carts. In addition, the team has designed and developed a number of hand tools to reduce the tedium in farm operations. Some of these hand tools are the Chitedze maize sheller, groundnut sheller, groundnut stripper and the grain mixing drum. These are now manufactured and marketed locally. Collaborative work with other commodity teams has led to the development of soil tillage and cultivation technologies for the smallholder farmers in order to increase crop yields, and control soil degradation.

(vi) **The Agro-forestry Commodity Team:**

The commodity team has developed several technologies such as alley cropping for conserving water and soil resources.

The team provides advisory services to a wide range of donor funded development activities in the country, such as the EU- sponsored ADDFOOD programme, FAO project for developing Soil Conservation Methods and Messages, Christian Service Committee (CSC), Action Aid and World Vision International (WVI).

(b) **Cereals:**

(i) **Maize**

The maize commodity team has developed and released several maize varieties. These include the dent hybrid MH12, the semi-flint hybrid MH17 and Chitedze composite C (CCC) for the long-season ecology; the dent hybrid MH16, the semi-flint hybrid MH18 and Chitedze Composite D (CCD) for the low-altitude ecologies. The release of semi-flint hybrids in 1990 has led to an increase in hybrid maize adoption by smallholders; from 12.9% of the maize area in 1990/91 to approximately 25% in 1992/93 was planted to hybrid maize.

The commodity team has also developed and selected several cultural practices such as early planting, weeding, optimum planting density. Several fertilisers have been evaluated, selected and recommended for use by smallholders. To improve fertiliser use efficiency and achieve optimum yields, the commodity team has recommended early fertiliser application, two split applications and optimum fertiliser rates for nitrogen and phosphorous. There has been a growth in fertiliser usage by smallholders of 15% from 1982/83 to 1990/91.

(ii) **Rice**

The significant achievements obtained for the irrigated rice in this country include the release of two high-yielding introductions, IET 4094 and IR1561-250-2-2, named Senga and Changu, respectively. Bluebonnet, an old popular variety was released in the late sixties. Only one local line, Faya 14 M69, was released in the early 70's.

The cultural practices developed for rainfed and irrigated growing conditions include dates of seeding and transplanting or dibbling, amounts of nitrogen and, sometimes, phosphate fertilisers to be applied, and other management practices such as spacings and plant densities.

(iii) **Wheat and Barley**

The Wheat and Barley commodity team has selected and released several wheat varieties. These are Kenya Nyati for rainfed areas, Palmeit, Torim 73, Loerie and Gamtoos for irrigated areas.

Several cultural practices have also been developed and released. These include early planting, optimum plant density and early weeding. Appropriate fertiliser types and rates have been evaluated and recommended for wheat. In addition, early and split fertiliser application and optimum fertiliser rates have been recommended to improve fertiliser use efficiency and yield. Four barley varieties were tested and recommended for brewing beer.

(iv) **Sorghum and millets**

Research conducted during the previous ten years led to identification and release of the sorghum introductions, Pilira 1, Pilira 2 and PN3 for food, and, PNR 8311 and Red Swazi for brewing. In addition, one pearl millet introduction, Nigerian composite, has been released for food.

(c) **Legumes, Fibre Crops and Oil Seeds**

(i) **Groundnuts:**

Several varieties have been developed for the confectionery trade and oil extraction. Manipintar and Mawanga varieties are for oil. Chalimbana, Chitembana, Malimba, RG1 and CG7 are for the confectionery trade. Research on agronomic practices has resulted in recommending groundnut planting on one row per ridge, 15 cm between planting stations, one seed per planting station. Pathological studies resulted in recommending Chlorothalonil fungicide for the control of foliar fungal diseases such as early and late leaf spots and leaf rust.

(ii) **Beans:**

Several varieties have been released such as Nasaka, Sapelekedwa, Bwenzilawana, Kamtsilo (early determinate types); Kanzama and Namajengo (late maturing and indeterminate). Other varieties that have been released include PVA 692, 21-5 and 25-2 x 8-7.

(iii) **Soya beans:**

Twelve varieties have been released and these include Hardee, Geduld, Davis, Bossier, Kudu, Impala, Ocepara-4 (root knot nematode resistant), Duocrop, Santarosa, 427/5/7, 501/6/12

and 491/6/7. Agronomic studies resulted in recommending the following cultural practices: planting on 90 cm ridges 2 rows per ridge 30 cm apart 5 cm between plants; or one row per ridge 2.5 cm between plants; and inoculation of seeds with the rhizobia inoculant 'SOY', before planting. Research has also indicated that soya beans can be grown in winter in irrigation schemes under residual moisture when planted in June/July.

(iv) **Pigeon peas:**

One variety, ICP 9145, has been released. This variety is very high yielding and is resistant to Fusarium wilt disease. Tentative agronomic practices have been recommended for both pure cropping and intercropping pigeonpeas with field crops. Recent disease surveys carried out in the southern part of the country have shown that the introduction of ICP 9145 for cultivation has had great impact on the food security of the farming community in Malawi. The wilt disease incidence has been reduced from an estimated 36.3% in 1980 down to a mere 4.0% in 1991; production loss due to wilt disease estimated at 57.0% in 1985/86 before release of ICP 9145 to less than 6.0% in 1991.

(v) **Cowpeas:**

One variety, Sudan 1, has been identified. This is an early maturing variety with semi-erect plant type. Agronomic practices have been recommended for cropping in pure stands which include planting on ridges 90 cm apart, 10 cm between planting stations, one plant per planting station.

(vi) **Cotton:**

Between 1933 and 1978, the Cotton Commodity Team released four varieties, produced fertiliser recommendations and introduced new methods of insect pest control. In recent years, area-specific cotton varieties have been released: EZAM-6 for the low altitude (Lower Shire Valley) areas, RASAM-17 for the Lakeshore and IRM-81 for the medium altitude areas (500-800 metres above sea level). Makoka 78 is still being grown in high altitude areas (above 1000 m.a.s.l.). These varieties are tolerant to bacterial blight disease caused by *Xanthomonas campestris pv malvecearum* and jassid, *Jacobiella fascialis* insect. Research on agronomic practices has resulted in the following specific recommendations: planting with the first effective rains, fertiliser application of 34 kg ha<sup>-1</sup> of nitrogen fertilisers, 45 kg ha<sup>-1</sup> of phosphate fertilisers, 22 kg ha<sup>-1</sup> of sulphur and 0.6 kg ha<sup>-1</sup> of Borate. Insect control measures have been developed using both the conventional and synthetic pyrethroids. Use of the persistent DDT for the control of the African bollworm has been replaced by synthetic pyrethroids and a carbamate insecticide, while advocating an integrated pest management (IPM) approach.

(vii) **Sunflower:**

Two sunflower hybrid varieties, PNR 7232 and SO323, were released in 1991 for commercial production in the country. These varieties have potential yields in excess of 3000 kg ha<sup>-1</sup> and oil content of more than 40%. Agronomic studies have resulted in tentative recommendations on the following cultural practices: time of planting, plant populations and fertiliser requirements and post-harvest technology. However, these practices are still being "fine-tuned".

(d) **Horticulture:**

The achievements in horticultural research include the identification and recommendations of different varieties which are high yielding and adaptable to Malawi conditions. These are:

(i) **Vegetables:**

Cabbage (Drumhead, Prize Drumhead, Golden Acre and Cape Spitzo); Chinese cabbage (Chihili, Wong-Bok and Pe-Tsai); Carrot (Chantenary, Early Cape Market and Nantes); Egg plant (Florida High Bush and Black Beauty); Lettuce (New York, Webbs Wonderful, Great Lakes, London White Cross and Butter Crunch); Melon (Charleston Gray); Okra (Clemson Spineless); Onion (De Wildt, Early Texas Grano, Pyramid, White Lisbon and Red Creole); Peas (Earlicrop, W.F. Massey, Green Feast, Onward and Alderman); Tomato (Money maker, Homestead and Roma) and mushroom (TNS1 and TN2).

(ii) **Root and Tuber Crops:**

Sweet potato (Kenya, TIS 3017, LRS 407); Potato (Rosita, Cardinal, Roslin Eburu, Roslin Castle, Mirka, Pentland, Pimpernel, Desiree, Vittorini, Spartaan, Up-to-date and Arka).

Cultural practices for Cassava varieties such as Gomani, Chitembwere, Mbundumali, Nyasungwi and local varieties; Babache, Yoyera and Kanchiputu, local varieties of sweet potatoes have been developed. A seed multiplication and distribution scheme for sweet potatoes and cassava has also been developed.

**(iii) Coffee:**

Geisha and Agaro.

**(iv) Tree Nut Crops:**

The following macadamia clones have been recommended and released: 246, 333, 508, 660, 344, 741 and 800.

**(v) Tropical Fruits:**

Mango (Haden, Kent, Davis Haden, Irwin, Tommy Atkins and Keitt); Banana (Kabuthu and Williams); Pineapple (Smooth Cayene and Queens); Avocado pears (Hass, Fuerte, Anheim and Collinson); Papaya (Solo and Washington); Guava (Apple Color, Chittidar, Lucknow 49, Safeda and Allahabad).

**(vi) Temperate Fruits**

Apple: Anna, Dorsett Golden, and Ein Shemer.

Pear: Hood and Flordahome.

Peach (Freestone): Flordared, Flordagrande, Flordaprince, Premier and 7-10.

Peach (Clingstone): Turquesa, Magno and Br 6.

Nectarine: Sunred.

Plum: Reubenel, Harry Pickstone, Satsuma, Gaviota and Royal Beauty.

**(e) Livestock and Pastures:**

The Livestock and Pasture commodity group has, in recent years, tested and recommended breeds of livestock suitable for milk production (Friesian, Jersey, Ayrshire crosses with Malawi Zebu), Malawi Zebu and Brahman crosses for beef production; Dorper sheep for meat production; developed management packages for improved production such as recommendations on rearing systems for calves for both dairy and beef cattle. Recommendations on management and nutrition of stall feeding steers for beef industry based on improved crop residue utilisation are in place. Recommendations on poultry production are in place based on local feed resources for small and medium farmers.

The recommended pastures are grasses such as Napier, Rhodes grass, Ntchisi panic, Star grass and Buffel grass while Silver leaf desmodium, Cook stylo, Centrocema and Siratro are the recommended legumes including leucena, a tree legume.

**(f) Plant Protection:**

The notable achievements by this commodity group include: the development of appropriate storage technologies for groundnut seed, potatoes and maize. These are being used by farmers. Bio-control and integrated pest management systems have been successfully implemented for the control of mealybug and pests in cassava and macadamia. Control measures for pests and diseases, including recommendations, have also been developed in various crops such as maize, cotton, potatoes, bananas and vegetables. Daconil was evaluated and proved to be less cost-effective. A system to restrict the introduction of exotic pests and diseases into Malawi is in place including produce inspection and quarantine services for export of pest-free agricultural produce. An advisory service for pest and disease control has been established. A new genus of parasitic nematodes has been identified in Malawi and all taxonomy work in nematology is done locally. An insect referral and pest forecasting system for armyworm has been established.

**(g) Technical Services:**

In the Seed services commodity team, an internationally-accredited seed certification and testing programme aimed at producing good quality seed for farmers is operational. The Agricultural Economics Statistics and Data Processing commodity team contributes significantly in performing ex-ante and post-ante evaluation of candidate technologies to assess their suitability; and most researchers are able to statistically analyse their research data on their own now as a result of the intensive hands-on in-country courses conducted by the Statistics section of the same commodity team. A library system is now functional with over 50,000 accessions; it is linked to the world-wide AGRIS Food and Agriculture Organisation of the United Nations (FAO).

**1.5.1.4. The Future of Agricultural Research****(a) Level of Public Investment**

The level of public investment in agricultural research in Malawi is relatively low amounting to 10.6% of the expenditure on agriculture or 0.5% of the agricultural GDP in 1994-95. The proposals set out in this edition of the Master Plan seek to raise this level of investment in research by more than 100% to above 1% of the agricultural GDP in real terms over a 5-year period. This increase in funding is necessary if the country is to maintain food self-sufficiency, encourage diversification of agricultural production and promote the production of exportable crops and livestock products. The additional funding desired for research would also provide for a more flexible



approach in tackling problems of national priority and addressing the most important production constraints. It is desirable to devote approximately 2.5% of the agricultural GDP to agricultural research by the year 2000.

**(b) Agricultural Services Project (ASP)**

Most of the NARP objectives have been achieved and these were mainly on building and improvement of infrastructure and manpower development. The project phased out in 1993. NARP did not provide any operational funds and hence implementation of research programmes was difficult. The government negotiated for operational funds to supplement revenue budget through the Agricultural Services Project (ASP). The ASP is financed under a development credit agreement with the International Development Association (IDA) through the World Bank and it was launched in December, 1993. The ASP is a six-year project (1993 - 1999) designed to integrate key agricultural services for smallholders and facilitate the implementation of institutional and management reforms for four key components, namely, agricultural research system, the agricultural extension system, the inputs supply system and institution building.

Under the agricultural research system, ASP will support priority agricultural action plans; strengthen research-extension - farmer linkages to ensure the development and transfer of appropriate technologies; diversify participation in publicly-funded research; activate an umbrella body to help set and update national research priorities and advise government on allocating public funds; improve research management systems; and enhance researchers' career structure, motivation and accountability.

Under NARP, there was a contract research programme which involved contracting research projects to institutions outside DAR. This programme had many problems, weaknesses and a few successes. The problems and weaknesses arose as a result of poor planning, hasty implementation of the programme and lack of a mechanism for monitoring, evaluation and feed-back.

The Government of Malawi has now reactivated the Agricultural Sciences Committee (ASC) as part of the ASP to help establish and co-ordinate national research priorities in all the research institutions of Malawi. One of the important functions of ASC is to award, administer and monitor contract research grants. ASC is important in augmenting the funding of some DAR research programmes through contract research. This contract research programme under ASC will take into account the reported weaknesses and problems faced under NARP contract research to ensure an improved and strengthened programme.

**(c) Other Funding Agencies**

Since public investment cannot address all research financial demands, DAR will continue to seek financial support from various donor agencies to implement agricultural research programmes besides ASP. Notable among these are the Overseas Development Administration (ODA), the Rockefeller Foundation, European Economic Community (EEC), Food and Agriculture Organisation of the United Nations (FAO), United Nations Development Programme (UNDP), United States Agency for International Development (USAID), CIDA, GTZ, IDRC, Organisation of African Unity (OAU), World Bank and The African Development Bank (ADB), among others. Some of the technical and financial assistance for research programmes in DAR will continue to be sourced from some of the international research institutions such as the International Institute of Tropical Agriculture (IITA) for research work on root and tuber crops; the International Crops Research Institute for the Semi Arid Tropics (ICRISAT) for research work on groundnuts and pigeon peas; Maize and Wheat Improvement Centre (CIMMYT) for breeding and soil fertility work in maize; International Livestock Research Institute (ILRI) for training scientists and technicians in the livestock and pastures group; CIP for training and germplasm exchange with the root and tuber crops commodity team; ICIPE for training; IRRI for germplasm and training; and also through regional groupings such as SADC.

**(d) Implementation of Trials**

Following the dissolution of the Adaptive Research Teams, each research commodity group will be involved in on-station and on-farm research. Each researcher will follow through his/her work up to the adoption phase. On-station research will be kept to a bare minimum to back-up on-farm research.

**(e) Annual Project Meetings**

Annual projects meetings have been instrumental in improving the standards of research programmes in DAR by ensuring that the experiments are demand-driven. The meetings have also been useful in strengthening research/extension linkages.

Without losing sight of the significant role these meetings have played in the department, a modified approach to holding them is planned for the future. Instead of discussing annual research results and proposals, only completed research work and new proposals will be discussed. The objectives of this approach are that conclusions of the findings from completed research work are made available to the extension workers faster than is the case now, and, by reducing their duration, these meetings will be less expensive. As for the on-going experiments, there should be mid-term evaluation by the NRCs and the Deputy Chief Agricultural Research

Officer responsible for research programmes to ensure that these experiments are properly focussed.

(f) **Release of Developed Technologies**

The Agricultural Technology Clearing Committee (ATCC) was formed to evaluate the suitability and appropriateness of new technologies developed by DAR and other research institutions before releasing them to farmers. Evident from the current situation is the fact that besides DAR there are, and there will be, several other institutions involved in the development and transfer of new technologies. Therefore, there should be explicit policies in place to control the flow of all such technologies from researchers to farmers. To achieve this, all new technologies developed by DAR and other NARS, including regional projects, should be vetted by the ATCC. This will ensure that only suitable and appropriate technologies are released to farmers. In the case of technologies developed by the regional projects, NARS should simply promote their adoption after the ATCC has vetted them.

1.5.2 **Impact of Research**

An understanding of the ways in which crops and livestock research may contribute to improve agricultural production is important in order for policy makers and financial donors to make sound decisions on the level of investment in agricultural research. High investment can be justified if the impact and rate of return are known. Impact assessment of agricultural research ought to form an integral part of research to generate the necessary data on impact of research.

The rate of return from research is high if results are transformed into practical ways of improving technology for use in growing crops and raising of livestock. The rate of return will also depend on how many of the technologies developed are used by farmers.

Research will have an impact on agricultural production if farmers can apply the technology. For them to do so, the necessary auxiliary inputs or services must be available and agricultural policies should offer incentives to enhance productivity.

The development of high yielding crop varieties and hybrids coupled with improved crop husbandry practices have contributed to increased crop production in this country. Breeding and selection of new varieties of crops have lessened the effects of pests and diseases on some crops. Improved and good quality seed through breeding have resulted in a viable agricultural production system for crops. Research on plant nutrition has resulted in an increase in fertiliser usage by smallholder farmers from 25,185 tonnes in 1972 to 185,849 tonnes in 1991. Work on nutrition and management of livestock have enabled the growth of sizeable poultry, beef and dairy industries.

Export value of a number of crops, also increased. Agro-industries have been strengthened due to availability of raw materials and technology. In reviewing the impact of research, however, it may be unfair to attribute all the improvement in agricultural production to only research. While research has had an important role of initiating these fundamental changes, agricultural extension and veterinary services too have played a significant role together with all others such as suppliers of agricultural inputs and buyers of agricultural produce who are involved in the production process.

1.6 **AGRICULTURAL PRODUCTION AND RESEARCH CONSTRAINTS**

There are a number of constraints which affect production of crops and livestock. These are human, technical, physical, financial, level of development, environmental, population pressure on land, policy and institutional constraints. These constraints are discussed in detail in Chapter 3.

1.7 **AIMS OF THE AGRICULTURAL RESEARCH MASTER PLAN**

The Master Plan provides a guideline for carrying out the proposed research strategies to make future research activities more effective in meeting the desired goal of increasing agricultural production and productivity, thus, contributing to the theme of poverty alleviation and overall development of the country. For these proposed research strategies to come into fruition, the career structure and manpower development for the scientists and support staff, and the increase in funding for research programmes should be implemented.

## RESEARCH ORGANISATIONAL STRUCTURE

## 2.1 POLICY AND MANDATE OF THE DEPARTMENT OF AGRICULTURAL RESEARCH

The Department of Agricultural Research (DAR) is within the Ministry of Agriculture and Livestock Development (MoALD)(Fig.2.1 and Table 2.1). It has the mandate to conduct both crops and livestock research at the national level. Research on commodities of high value, such as tea, tobacco and sugarcane, is carried out by other research institutions within Malawi. Research in animal health is carried out by the Department of Animal Health and Industry (DAHI).

The policy of agricultural research in Malawi is to plan and conduct applied or production-oriented research work that will generate information and technologies which can be directly utilised by smallholder farmers to solve technical production problems which are bottle-necks to their increased output per unit area or unit animal or unit volume of water. The estate sector, food processing and agrochemical companies also benefit from this research focussed on problems for smallholders.

## 2.1.1 Background

At Independence in 1964, the DAR was a small organisation consisting of mainly expatriate scientists. Research then was organised on a project basis, by crop, livestock or discipline, and was carried out in a network of 11 main research stations, nine sub-stations and 220 trial sites scattered throughout the country. The research funds were allocated to the research stations and the Officers-in-Charge in turn allocated the funds to each project.

The scope and size of DAR was enhanced in 1975 when the responsibility for research on cotton, grain legumes and soil productivity was given to DAR at the dissolution of the Agricultural Research Council of Malawi. In 1980, the DAR relinquished the responsibilities for research on tobacco and this task was taken over by the Agricultural Research and Extension Trust (ARET), formerly known as the Tobacco Research Institute of Malawi (TRIM).

During the period 1980-1984, USAID assisted DAR in overseas graduate training of a large number of Malawian scientists. This training has greatly enhanced DAR's capability to carry out its research functions. The second phase of graduate training of Malawian scientists started in 1986 under the USAID and World Bank programmes; this terminated in 1993. Meanwhile, post graduate training is going on under various donor agencies and collaborating international organisations such as the Rockefeller Foundation, the African Development Bank (ADB), Overseas Development Administration (ODA), the Food and Agriculture Organisation (FAO), United Nations Development Programme (UNDP), and the Germany Agency for Technical Co-operation (GTZ).

In 1983, it was felt necessary to re-assess the role, structure and functions of the DAR and to outline a new strategy so that the contribution of DAR to the continued development of the agricultural industries could be maximised. In 1985, DAR's research projects were re-organised into multidisciplinary commodity groups and an Agricultural Research Council (ARC) was formed whose major function is to set policy guidelines within which DAR should operate.

## 2.1.2 Current DAR Organisation

The DAR was re-organised in 1985 to facilitate research priority setting, to relate research resources allocation to the national importance of commodities and to improve the quality and quantity of the output from the research system. Under the new system, a sharper focus is placed on the management of the multidisciplinary commodity research programmes, the plant protection services and the technical services.

The basic feature of the re-organisation was the change from the research station structure, in which the Officers-in-Charge were directly responsible for all research projects at their stations, to a nationally coordinated and integrated multidisciplinary team approach to research. Research is now organised into five commodity and two services groups, each group being led by a NRC. The NRC is a senior research scientist responsible for research programmes, not administration, and is based at a research station. Each commodity group is composed of several multidisciplinary research teams known as Commodity Teams. Each commodity team is led by a CTL who is a senior research scientist.

Technically, the CTL is responsible to the NRC, who, in turn, is responsible to the two Deputy Chief Agricultural Research Officers (DCAROs) : the DCARO for research programmes (DCARO(RP)) and the DCARO for Technical Services and Administration (DCARO(TSA)) based at the DAR headquarters. The five commodity and two services groups are:

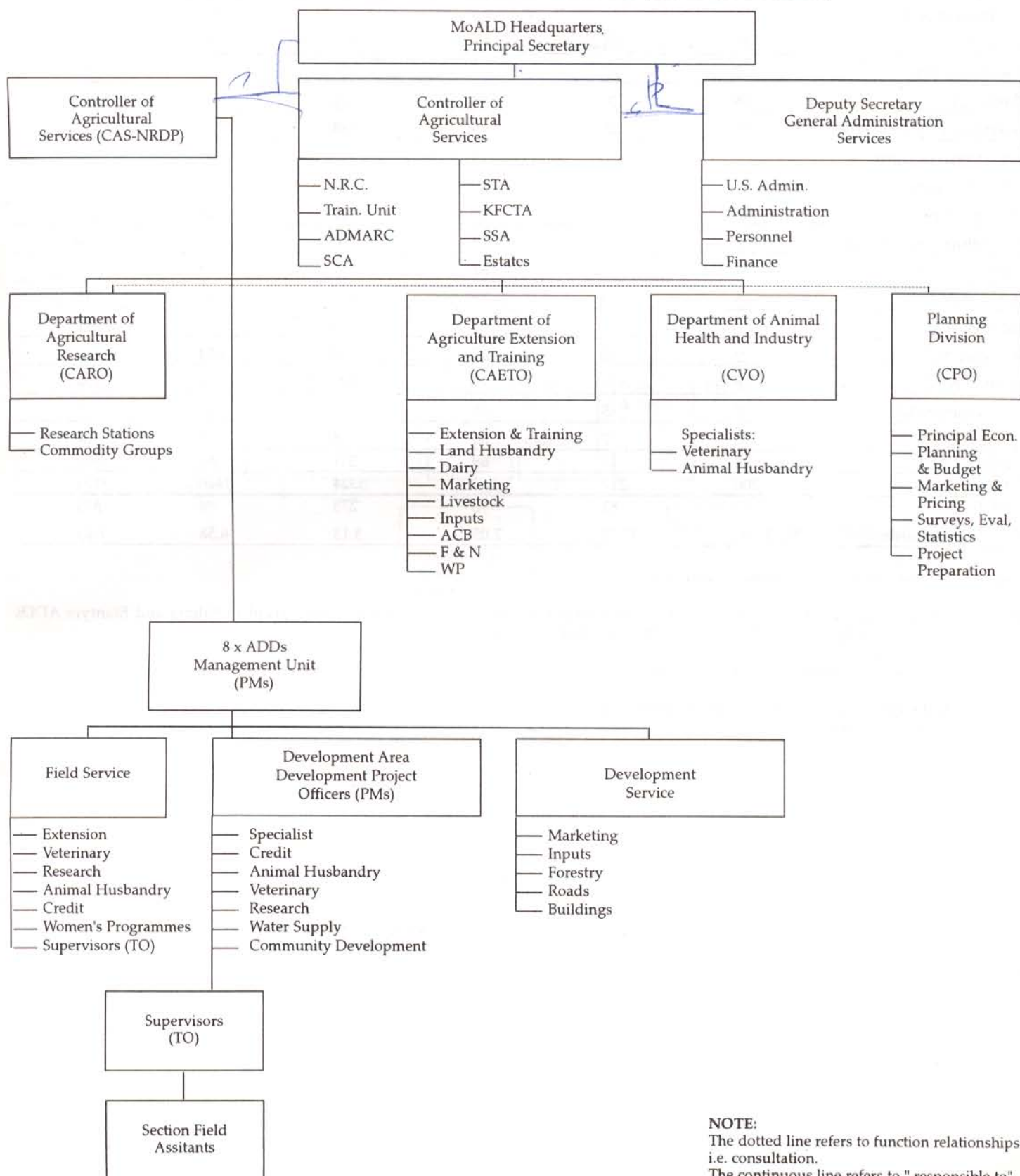
- (a) Cereals
- (b) Horticulture
- (c) Grain Legumes, Fibres and Oilseeds
- (d) Livestock and Pastures
- (e) Soils and Agricultural Engineering

- (f) Technical Services  
(g) Plant Protection Services

The research strategies of these commodity groups are discussed in detail in Section 3.3 of Chapter 3.

To perform its function effectively, DAR operates within a set of guidelines and realities of the national budget. The responsibility of guiding DAR is vested in the ARC, which is an appropriately constituted body of persons with different perspectives of agriculture and the economy in general. The responsibilities and the composition of this body are outlined in Section 2.2. The Chief Agricultural Research Officer is responsible for the overall implementation of the agricultural research policy.

### MINISTRY OF AGRICULTURE ORGANOGRAM (UNDER REVISION)



**NOTE:**

The dotted line refers to function relationships i.e. consultation.

The continuous line refers to "responsible to".

Fig. 2.1 Organogram of MoALD

Table 2.1: Staff Establishment of the Ministry of Agriculture and Livestock Development.

|   | SUPER<br>SCALE<br>STAFF<br>GRADE | PROF.<br>OFFICER<br>(PO) | OFFICER<br>(TO) +<br>EQUIV. | TECHN.<br>ASST.<br>(TA) +<br>EQUIV. | TECHN.<br>SUPPORTING<br>STAFF<br>(SS) | TOTAL |
|---|----------------------------------|--------------------------|-----------------------------|-------------------------------------|---------------------------------------|-------|
| Ministry of Agriculture                   |                                  |                          |                             |                                     |                                       |       |
| Headquarters                              | 22                               | 7                        | 30                          | 68                                  | 18                                    | 145   |
| Department of Agric.                      |                                  |                          |                             |                                     |                                       |       |
| Research                                  | 33                               | 81                       | 92                          | 273                                 | 96                                    | 575   |
| Natural Resources College                 | 12                               | 0                        | 25                          | 50                                  | 24                                    | 111   |
| Planning Division                         | 18                               | 20                       | 10                          | 84                                  | 1                                     | 133   |
| Veterinary Department                     | 30                               | 25                       | 131                         | 588                                 | 172                                   | 946   |
| Department of Agric.<br>Ext. and Training |                                  |                          |                             |                                     |                                       |       |
| Headquarters                              | 22                               | 11                       | 45                          | 121                                 | 21                                    | 220   |
| Agriculture Communication                 | 4                                | 3                        | 19                          | 50                                  | 34                                    | 110   |
| Karonga ADD                               | 9                                | 5                        | 52                          | 308                                 | 62                                    | 436   |
| Mzuzu ADD                                 | 8                                | 9                        | 79                          | 395                                 | 48                                    | 539   |
| Kasungu ADD                               | 8                                | 10                       | 94                          | 498                                 | 67                                    | 677   |
| Lilongwe ADD                              | 9                                | 12                       | 127                         | 959                                 | 653                                   | 1,760 |
| Blantyre ADD                              | 8                                | 9                        | 79                          | 595                                 | 67                                    | 758   |
| Shire Valley ADD                          | 7                                | 5                        | 51                          | 470                                 | 38                                    | 571   |
| Salima ADD                                | 8                                | 7                        | 64                          | 354                                 | 73                                    | 506   |
| Machinga ADD                              | 8                                | 13                       | 69                          | 511                                 | 86                                    | 687   |
| TOTAL                                     | 206                              | 217                      | 967                         | 5324                                | 1460                                  | 8174  |
| DAR Total                                 | 33                               | 81                       | 92                          | 273                                 | 96                                    | 575   |
| As % of the Ministry                      | 16.02                            | 37.32                    | 7.05                        | 5.13                                | 6.58                                  | 7.03  |

Source: Treasury, Ministry of Finance, April 1994

Note: The total staff Establishment of the MoALD is financed directly with revenue funds, except in Salima and Blantyre ADDs which presently receive support from the World Bank for a minor part of their personnel.

Some of the Technical Officers and Technical Assistants are on secondment to Crop Authorities i.e. SCA, SSA, STA

ADD figures cover all staff members including Land Husbandry branches

### DEPARTMENT OF AGRICULTURAL RESEARCH

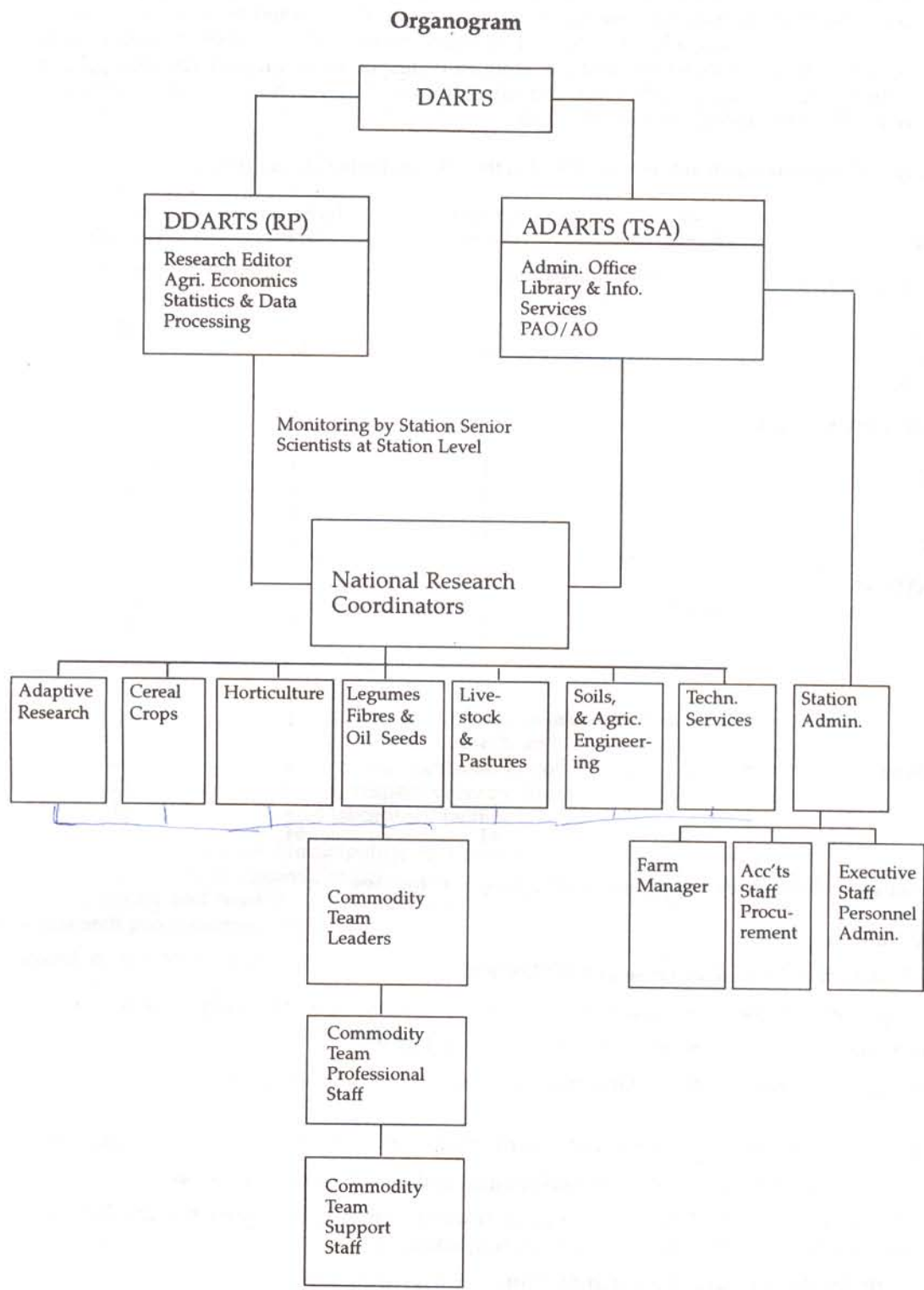


Fig 2.2 Organogram of DAR as amended by May, 1997

### 2.1.3 Physical Infrastructure

The experimental work carried out by scientists requires representative conditions in each of the ecological zones, and a research station network is essential if this work is to be conducted efficiently. While it is desirable that the major ecological zones are adequately covered by a research station and experimental station or sub-station, a balance should be struck between the number of research stations, each of which requires overhead expenses, and the amount of resources to support research programmes. The current network of research, experimental and sub-stations of DAR is shown in Table 2.2 including the distribution of DAR's staff among the establishments.

Table 2.2: Summary of Current Research and Technical Staff in the DAR excluding Headquarters

| Institutions                     | Senior Scientists | Research Officers | Technicians Grade | Technicians Assistants | Field Total |
|----------------------------------|-------------------|-------------------|-------------------|------------------------|-------------|
| <b>(a) RESEARCH STATION</b>      |                   |                   |                   |                        |             |
| Bvumbwe                          | 3                 | 16                | 20                | 42                     | 81          |
| Chitedze                         | 14                | 28                | 24                | 91                     | 157         |
| Lunyangwa                        | 2                 | 4                 | 3                 | 19                     | 28          |
| <b>(b) EXPERIMENTAL STATIONS</b> |                   |                   |                   |                        |             |
| Kasinthula                       | -                 | 4                 | 1                 | 11                     | 16          |
| Makoka                           | 2                 | 4                 | 8                 | 23                     | 37          |
| Lifuwu                           | -                 | 3                 | 2                 | 9                      | 14          |
| Mkondezi                         | -                 | 1                 | 2                 | 9                      | 12          |
| <b>(c) SUB-STATIONS</b>          |                   |                   |                   |                        |             |
| Baka                             | -                 | 1                 | 2                 | 15                     | 18          |
| Bembeke ✓                        | -                 | -                 | -                 | 1                      | 1           |
| Bolero                           | -                 | -                 | -                 | 2                      | 2           |
| Chitala ✓                        | -                 | -                 | 1                 | 12                     | 13          |
| Mbawa                            | -                 | -                 | 1                 | 7                      | 8           |
| Meru                             | -                 | -                 | -                 | 8                      | 8           |
| Nchenachena                      | -                 | -                 | -                 | 3                      | 3           |
| Ngabu                            | -                 | -                 | -                 | 12                     | 12          |
| Tsangano ✓                       | -                 | -                 | -                 | 1                      | 1           |
| <b>TOTAL</b>                     | <b>21</b>         | <b>61</b>         | <b>64</b>         | <b>265</b>             | <b>411</b>  |

The definitions of each of the three categories of stations are as follows:

#### (a) Research Stations

A research station is defined as a research facility which:

- is headquarters for one or more commodity teams and perform all the analyses of their research results;
- has in residence ten or more scientists at PO level and above;
- has adequate laboratory, library, land and workshop facilities to service the needs of commodity teams resident there;
- receives budgetary allocations on revenue for both administration and research programme expenses;
- co-ordinates the activities of experimental stations and sub-stations in a region.

On the basis of this definition, only 3 stations qualify as research stations; these are Chitedze, Bvumbwe and Lunyangwa. A summary of the facilities at each of these stations is as follows:

#### (i) Chitedze Agricultural Research Station

Situated 16 km from Lilongwe in the Central Region, Chitedze is the major crop and livestock research centre with 42 researchers. The maize, groundnut, grain legumes, livestock, pasture, agricultural economics, statistics and data processing (AGREDAT), library and information services, gene bank, crop storage, oilseeds, farm machinery, wheat, seed technology, produce inspection, plant pathology and soils commodity teams are headquartered at Chitedze. The station has about 486 ha of land, a library complex, workshop and several laboratories. The SADC/ICRISAT Groundnut and Pigeonpea Project, the International Institute of Tropical Agriculture (IITA) Root and Tuber Crops programme, ICRAF and CIAT Beans Programme have their zonal offices at Chitedze.

#### (ii) Bvumbwe Agricultural Research Station

Situated 19 km from Blantyre in the Shire Highlands, Bvumbwe is the main horticultural research centre. The major crops are vegetables, fruits, tree nuts, coffee, root and tuber crops and mushrooms. Extensive research work is also carried out on soil fertility, plant nutrition and plant protection. Advisory services are provided by the Soils and Plant Protection Commodity Teams. The station has a seed testing laboratory

The Chinese Technical Mission, which is based at the station, is engaged in the production of seed of such crops as squash, tomatoes, water melons and cucumbers; the seeds of these crops are not produced by their Malawian counterparts in order to avoid duplication. The station has 19 scientists in residence, 200 ha of arable land, several laboratories, library and workshop facilities. There is also a guest house which is used for in-service training.

(iii) **Lunyangwa Agricultural Research Station**

This research station is located 4 km NE of Mzuzu city centre in the Northern Region. It is a centre for dairy livestock research, biological control of the cassava mealybug under the GTZ and other cassava research work. The station also carries out research on coffee, legumes, macadamia and pastures. There are 6 resident scientists, 240 ha of land, laboratory, library, motor vehicle and plant equipment workshop facilities.

(b) **Experimental Stations**

Several important ecological zones are not adequately covered by the three research stations. Hence, experimental stations are located in selected ecological areas for applied research work on important crops and livestock in those areas.

An experimental station is defined as a research facility which has 3 of these requirements:

- should have scientists at PO level;
- is headquarters for at least one commodity team or none;
- may have the basic laboratory, workshop and library facilities and has adequate land to service the needs of the commodity team in residence or for research planned by non-resident scientists; and
- receives budgetary allocations on revenue for both administration and research programme expenses. The stations which, qualify as experimental stations are Mkondezi, Lifuwu, Makoka and Kasinthula.

**Mkondezi:** located 12 km West of Nkhata Bay district headquarters, is a new station with several facilities to service research activities and other needs of a station. The centre is in an ecology suitable for tropical fruits and, roots and tubers crops. The total research area is 85 ha. The station has an excellent motor vehicle workshop and cold room facilities and has one resident scientist.

**Lifuwu:** located 25 km East of Salima township in the Central Region lake shore area, is a centre for rice research and rice basic seed production. There are 11 ha of paddy for rice research and over 10 ha for dry land crop research on maize, coconut and cashew nut, bean, cowpea and soya bean research is conducted in the paddy fields. Rice basic seed and certified seed are produced on 16 ha and 30 ha, respectively, by the Salima ADD. The centre has 3 resident research scientists, a small vehicle workshop, library and laboratory facilities.

**Makoka:** located 20 km south of Zomba Municipality, is a major cotton research centre. The station is also used for experiments on several crops such as cassava, maize, pigeon peas, sweet potatoes and agro-forestry. It has 200 ha of research land; laboratory, library and workshop facilities. Besides the national programmes, the station is a site for ICRAF and FAO/UNDP V research programmes. The station has 6 resident scientists.

**Kasinthula:** is located in the Shire Valley about 60 km south of Blantyre City. The station specialises in Irrigation Agronomy. Other experimental programmes are on spices, rice, sorghum, millet, vegetables, cassava, fruits and cotton. The station land is about 85 ha of which 40 ha are for research purposes and 45 ha for seed multiplication and small-holder rice production under the auspices of the Shire Valley ADD, formerly Ngabu ADD. There are laboratory, library and workshop facilities and 4 resident scientists.

(c) **Substations**

A substation is defined as a facility which:

- has sufficient land for conducting controlled experiments which have been designed by non-resident scientists for which site work is needed in this location;
- conveys the experimental results to the non-resident scientist for analysis;
- has no inherent need for laboratory and library facilities, but may need storage facilities and sheds for equipment and implements;
- does not have resident scientists but the site is managed by an experienced technical officer and/or technical assistants;
- receives no budgetary allocation for administrative expenses. Administrative expenses are borne by the parent research station whereas the commodity team conducting its research work on the site provides for research programme costs.

Substations cover those ecological areas not well covered by research and experimental stations. In the Northern Region, where there are extreme variations in ecology, there are five substations namely Meru in Chitipa; Baka in Karonga; Mbawa in Mzimba; Bolero and Nchena-chena in Rumphi. The substations in the Central Region are Bembeke, Chitala and Tsangano. Ngabu is the only substation in the Southern Region.

Besides the sub-stations, there are several trial sites in specific crop ecological zones. Some of these sites are manned by a single field assistant and others by skilled work men. Examples of such sites include Misuku Hills for deciduous fruit and tree nut crops, Domasi, Hara and Limphasa for rice, Lupembe for groundnuts and Thuchila for maize.



2.1.4 Human Resources

As of January, 1995, the levels of academic qualifications and staging levels of research staff in DAR are presented in Tables 2.3 through 2.5

Since 1980, DAR has lost 13 PhD scientists and 23 M Sc holders to other departments, private sector and international organisations due to several factors amongst which is poor conditions of service for scientists

Included in Table 2.3 are one PhD scientist on unpaid leave, 3 PhD scientists on secondment, 1 MSc scientist on secondment, 8 MSc scientists pursuing graduate training leading to PhD degrees at various universities, and 5 BSc scientists pursuing MSc degrees. This number of staff currently in training represents about 15% of the DAR professional staff establishment

Table 2.3: Research Staff of DAR as of January, 1995.

|              | QUALIFICATION |      |      |            | Total | Estab-lishment | Vac. |
|--------------|---------------|------|------|------------|-------|----------------|------|
|              | PhD           | MSc. | BSc. | Non Degree |       |                |      |
| P8 and above | 3             | 11   | 1    | -          | 25    | 33             | 8    |
| PO           |               | 7    |      | 37         | 17    | -              | 61   |
| 80           | 19            |      |      |            |       |                |      |
| CTO          | 4             | -    |      | -          | -     | 4              | 4    |
| 8            |               |      |      |            |       |                |      |
| STO          | 5             | -    |      | -          | -     | 11             | 11   |
| 16           |               |      |      |            |       |                |      |
| TO           | 5             | -    |      | -          | -     | 11             | 11   |
| 68           | 19            | -    |      | -          | -     | 49             | 49   |
| STA          |               |      |      |            |       |                |      |
| 33           | 9             | -    |      | -          | -     | 24             | 24   |
| T.A.         | -             | -    | 245  | 245        |       |                |      |
| TOTAL        | 20            | 48   | 18   | 333        | 228   | (17)           | 47   |
|              |               |      |      |            | 419   | 466            |      |

The figures in Table 2.3 do not include expatriate staff working in DAR on short term contracts.

Table 2 4: Breakdown of Professional Staff of DAR

| COMMODITY           | Administration |     |     | Plant Breeders |     |     | Agronomists |     |     | Plant Protection |     |     | Soil Scientists |     |     | Economists |     |     | Biometricians |     |     | Agriculture Edngibneering |     |     | Animal Breeders |     |     | Animal Animal Nutrition |     |     | Report Phys. |    |   | Total |
|---------------------|----------------|-----|-----|----------------|-----|-----|-------------|-----|-----|------------------|-----|-----|-----------------|-----|-----|------------|-----|-----|---------------|-----|-----|---------------------------|-----|-----|-----------------|-----|-----|-------------------------|-----|-----|--------------|----|---|-------|
|                     | PhD            | Msc | Bsc | PhD            | Msc | Bsc | PhD         | Msc | Bsc | PhD              | Msc | Bsc | PhD             | Msc | Bsc | PhD        | Msc | Bsc | PhD           | Msc | Bsc | PhD                       | Msc | Bsc | PhD             | Msc | Bsc | PhD                     | Msc | Bsc |              |    |   |       |
| Maize               |                |     |     | 0              | 3   | 0   | 1           | 3   | 0   |                  | 0   | 0   |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 6  |   |       |
| Sorghum & Millet    |                |     |     |                | 1   |     |             |     | 0   |                  | 0   | 0   |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 1  |   |       |
| Wheat & Barley      |                |     |     |                | 1   |     |             |     | 0   |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 1  |   |       |
| Rice                |                |     |     | 0              | 1   |     |             |     | 1   |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 2  |   |       |
| Groundnuts          |                |     |     | 1              |     |     | 1           | 1   |     |                  | 0   |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 3  |   |       |
| Cotton              |                |     |     |                | 1   |     |             |     |     | 1                | 0   |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 2  |   |       |
| Oilseeds            |                |     |     | 0              |     |     |             |     | 2   |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 2  |   |       |
| Other Grain Legumes |                |     |     |                | 1   | 1   |             |     | 1   | 1                | 0   |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 4  |   |       |
| Beans*              |                |     |     | 1              |     |     |             |     |     |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 1  |   |       |
| Temperate Fruits    |                |     |     |                |     | 1   | 0           |     |     |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 1  |   |       |
| Tropical Fruits     |                |     |     |                |     |     |             | 1   |     |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 1  |   |       |
| Tree Nuts           |                |     |     |                |     | 1   | 0           |     |     |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 1  |   |       |
| Vegetables          |                |     |     |                |     |     | 1           | 1   | 1   |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 3  |   |       |
| Cassava & Potatoes  |                |     |     |                | 1   |     | 0           | 1   | 1   | 0                | 0   |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 3  |   |       |
| Coffee              |                |     |     |                | 1   | 0   |             | 1   |     |                  | 1   |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 3  |   |       |
| Livestock           |                |     |     |                |     |     |             |     |     |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     | 1               | 0   |     | 2                       | 1   |     | 1            | 0  | 5 |       |
| Pastures            |                |     |     |                |     |     |             | 2   |     |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 2  |   |       |
| Soils               |                |     |     |                |     |     |             |     |     |                  |     |     | 4               | 1   | 4   |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 9  |   |       |
| Crop Storage        |                |     |     |                |     |     |             |     |     | 1                |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 1  |   |       |
| Irrig & Drainage    |                |     |     |                |     |     |             | 2   |     |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 2  |   |       |
| Plant Protection    |                |     |     |                |     |     | 0           | 0   | 5   | 8                | 5   |     |                 |     |     |            | 0   | 0   |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 18 |   |       |
| AGREDAT             |                |     |     |                |     |     |             |     |     |                  |     |     |                 |     |     | 1          | 1   |     | 0             | 1   |     |                           |     |     |                 |     |     |                         |     |     |              | 3  |   |       |
| Seed Services       |                |     |     |                |     | 1   |             | 0   | 0   | 0                | 0   |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 1  |   |       |
| Library Services    |                | 1   |     |                |     |     |             |     |     |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 1  |   |       |
| Agro-forestry       |                |     |     |                |     |     |             | 2   |     |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         | 1   |     |              | 3  |   |       |
| Farm Machinery      |                |     |     |                |     |     |             |     |     |                  |     |     |                 |     |     |            |     |     |               |     | 2   | 1                         |     |     |                 |     |     |                         |     |     |              | 3  |   |       |
| Gene Bank           |                |     |     |                |     | 2   |             |     |     |                  |     |     |                 |     |     |            |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 2  |   |       |
| Administration      |                |     | 2   | 2              |     |     |             |     |     |                  |     |     | 1               |     | 1   | 1          |     |     |               |     |     |                           |     |     |                 |     |     |                         |     |     |              | 8  |   |       |
| TOTAL               |                | 1   | 2   | 4              | 13  | 1   | 5           | 17  | 4   | 6                | 9   | 5   | 4               | 2   | 4   | 1          | 2   | 1   |               |     | 1   | 2                         | 1   |     | 1               | 1   | 3   | 1                       |     | 1   |              | 92 |   |       |

\*Bean physiology, entomology and culinary studies are carried out by Bunda College of Agriculture

Table 2.5 Shows the distribution of DAR professional staff among research disciplines

Table 2.5 Distribution of DAR Scientists among Research Disciplines as of January, 1995

| Discipline              | No. of Scientists | % of Total    |
|-------------------------|-------------------|---------------|
| Library                 | 1                 | 1.20          |
| Soil Science            | 7                 | 7.69          |
| Soil Microbiology       | 2                 | 2.30          |
| Crop Agronomy           | 24                | 26.37         |
| Plant Breeding          | 12                | 20.98         |
| Entomology              | 10                | 11.00         |
| Plant Pathology         | 9                 | 8.79          |
| Seed Technology         | 2                 | 2.33          |
| Farm Machinery          | 2                 | 4.40          |
| Animal Science          | 7                 | 7.69          |
| Statistics              | 1                 | 1.01          |
| Agroforestry            | 1                 | 1.01          |
| Agric Economics         | 3                 | 3.03          |
| Plant Genetic Resources | 2                 | 2.20          |
| <b>TOTAL</b>            | <b>83</b>         | <b>100.00</b> |

## 2.2 AGRICULTURAL RESEARCH COUNCIL

The ARC was established to set policy guidelines within which DAR has to operate.

### 2.2.1 Functions of the ARC

- (a) Ensure that the agricultural research strategy is consistent with national agricultural development goals;
- (b) outline an agricultural research policy that is compatible with and supportive of national goals;
- (c) approve annual research programmes and projects for implementation by DAR;
- (d) consider and recommend contract research proposals, including the level of funding;
- (e) recommend an appropriate level of expenditure in agricultural research, with the target of eventually investing at least one percent of the annual value of the agricultural gross domestic product (GDP) and
- (f) prepare the Agricultural Research Master Plan which allocates priorities according to national goals.

### 2.2.2 Composition of the ARC

The original ARC attempted to fulfil its mandate and to carry out its functions. However, it failed to be effective probably because, among other things, its chairman was looked upon as an outsider and also because there is no permanent secretariat to run its day-to-day affairs.

Currently the ARC is composed of:

- Chairperson : Elected from amongst members
- Alternate : Elected by members
- Secretary : The Chief Agricultural Research Officer (CARO)
- Member : Principal Secretary for the Treasury
- Member : Representative of NGOs (CONGOMA)
- Member : Principal Secretary for Forestry/Natural Resources
- Member : University of Malawi Research Co-ordinator
- Member : Representative of Agricultural Research and Extension Trust (ARET)
- Member : Representative from the Pesticides Association of Malawi (POSAM)
- Member : Representative from Tea Research Foundation (TRF)
- Member : Representative of Smallholder Farmers – CAETO
- Member : Chief Veterinary Officer
- Member : Chief Planning Officer
- Members : 2 eminent scientists

### 2.2.3 ARC Secretariat and Subcommittees

For the ARC to conduct its functions efficiently, an ARC secretariat in DAR's headquarters was established. The secretariat is responsible for preparing the Master Plan in collaboration with all researchers, and organising triennial

reviews of the research system. The ARC has two subcommittees: Technical Subcommittee which examines and reviews research programmes and proposals, the Financial Subcommittee which examines the annual budgets and scrutinises the estimates of programmes and projects' costs. Recommendations of the subcommittees are considered by the Agricultural Research Council at its general meetings. To make ARC more effective in DAR there is need for the secretariat to be serviced by full time staff comprising of a chief scientific officer at P5 grade (Fig. 6.2).

## 2.3 PLANNING AND COORDINATION OF RESEARCH PROGRAMMES

This proceeds through five stages as described in the following sections:

### 2.3.1 Setting Overall Research Priorities

This is a task assigned to the ARC, where the overall national as well as specific ADDs' research priorities are set. The ARC employs a set of guidelines for priority setting and draws heavily on the desired national goals embodied in the 1987-1996 Statement of Development Policies. The criteria used for priority setting include national goals, research and technical factors.

### 2.3.2 Priority Setting within Commodities

This is a task assigned to the NRCs and CTLs who ensure that priorities set within research commodities are in line with the nationally set priorities, taking into account the human, financial and physical resources available to the commodity. Criteria for priority setting within the commodities are outlined in section 4.7 of Chapter 4.

### 2.3.3 Programme Planning and Budgeting

Prior to the fiscal year 1992/93, the allocation of DAR funds under revenue account was primarily done on the basis of research station needs rather than through systematic planning on the basis of research programme priorities. An analysis of expenditure patterns revealed that a large percentage of available funds were used for research station overheads and that very little funds were left for research programmes. Administrative overheads have been reduced by closing some of the least crucial stations and facilities to allow for more flexibility for financing high priority research programmes.

The multidisciplinary team approach to research programmes, with commodity groups and teams being the focus of the planning and budgeting process rather than the stations, provides a more rational and accountable basis for programme planning and budgeting.

Under the current system, the budgeting process is co-ordinated and directed by the Financial Controller and the Research Economist. The CTLs are responsible for preparing work plans and preliminary budget requests for their respective commodity teams. To do this, they ask for estimates of farm inputs such as the amount of seed, fertilisers, chemicals, transport and travelling, labour and miscellaneous items needed for their programmes, from each team member. These requests are consolidated into work plans and budget proposals which are then submitted to their respective NRCs who collate them into unified budget proposals for consideration by the Deputy CARO (RP).

Similar activities are carried out under the direction of the Deputy CARO (TSA) to prepare budget proposals for research stations' development, operation and maintenance of the service groups such as the Plant Protection group and Technical Services group of DAR and for salaries and wages of DAR personnel. The budgeting process implies a lead time of several months, and the timing of the annual cycle for revenue budgets is approximately as follows:

- SEPTEMBER:** Work plans and budget proposals of NRCs of the five commodity groups are submitted to the Deputy CARO (RP). Similarly, budget proposals of Officers-in-Charge and NRCs of the two service groups are submitted to the Deputy CARO (TSA).
- OCTOBER:** CARO completes review of proposed research programmes and budgets and then submits these to the ARC.
- NOVEMBER:** The ARC makes its recommendations to the Principal Secretary, MoALD. The total proposed DAR budget is compiled.
- DECEMBER:** MoALD submits its aggregate budget estimates to the Treasury.
- JANUARY:** Treasury reviews the budget estimates, and may request one or more meetings for clarification or further justification.
- FEBRUARY:** Treasury submits the budget estimates to Parliament.
- MARCH:** Parliament acts on budget.
- APRIL:** The first quarterly allocation is made to stations and programmes. The proposed DAR budget is revised according to Parliament's allocation and the priorities defined by the ARC. The second, third and fourth quarterly allocations are made according to the revised budget.

### 2.3.4 Implementation of Field Trials

This task is the responsibility of research scientists, CTLs and NRCs. The research scientists implement the trials. In addition to executing their own trials, CTLs ensure that all the needed resources are made available on time for the researcher to implement the trials; the NRCs direct, conduct and integrate research on a commodity or problem in a co-ordinated manner to ensure that there is a balanced focus on the production problems faced by farmers.

### 2.3.5 Monitoring and Evaluation

Monitoring and evaluation (M&E) are management tools which provide effective means of reviewing the progress of research programmes to ensure that the activities are carried out according to stated goals and objectives. M & E also provide a feedback for potential deviations of research programmes from planned action before the activities go out of hand. In this way, priorities may be reviewed and future research directed to meet desired objectives. Systematic procedures for M & E already exist in DAR and should continue to be used to ensure the correct planning, implementation and reporting of research programmes.

Each researcher is responsible for monitoring his/her own research projects throughout the implementation period. On-site monitoring of research activities within a commodity group is undertaken by the NRC who discusses progress with the CTL and research scientists on current results and problems of on-going programmes. Annual meetings are convened by the NRC at a predetermined time each year (usually in August) to review progress of research activities during the past season. New problems that need attention, outlines of work plans and proposed budgets for the next season are also discussed.

The reports for the previous season include technical accomplishments and/or failures. The DCARO (DAR), NRCs, CTLs, key research scientists, subject matter specialists from all the eight ADDs and DAE representatives from agrochemical industries, representatives from various NGOs and collaborating research institutions often participate in these reviews.

Triennial Reviews for donor-funded projects are usually convened by CARO to review the research projects under DAR. Selected research specialists from both within and outside Malawi are invited to participate. These specialists provide specific suggestions on the availability of new information and materials from other sources and make positive suggestions on applied and on-farm research work under DAR. Table 2.6 shows the chronological sequence of meetings and report of activities.

Table 2. 6 DAR's Chronology of Meetings and Reports

| Type of Meeting and Report              | Participation or Produced by     | Participation or Addressed by  | J | F | M | A | M | J | J | A | S | O | N | D |
|---|----------------------------------|--------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly Report                          | Ground Level Researchers         | CTL                            | X | X | X | X | X | X | X | X | X | X | X | X |
| Quarterly Report                        | CTL                              | DCARO                          |   |   |   | X |   |   |   | X |   |   |   | X |
| Research Report Planning Meetings       | Ground Level Researchers and CTL | NRC                            |   |   |   |   |   |   | X | X |   |   |   |   |
| Research Report & Planning and Meetings | CTL, NRC DCARO                   | CARO                           |   |   |   |   |   |   |   |   |   |   |   |   |
| Annual Reports                          | CTL                              | NRC                            |   |   |   |   |   |   |   |   |   | X |   |   |
| Annual Reports                          | Reviewed by NRC, DCARO and CARO  | Presented to ARC               |   |   |   |   |   |   |   |   |   |   | X |   |
| Annual Budget                           | ARC                              | Presented to Treasury          |   |   |   |   |   |   |   |   |   |   |   |   |
| ARC Meetings                            | CARO DCARO and ARC Members       | Principal Secretary            |   |   | X |   |   | X |   |   |   | X |   | X |
| External Review                         | NRC, DCARO and CARO              | Donor Agencies and Int Centres |   |   |   |   |   |   |   |   |   |   |   |   |

Triennial

## 2.4 DAR's Interaction with National Institutions

Agricultural research in Malawi is conducted by several institutions. There is, therefore, a strong need for inter-institutional co-ordination to utilise scarce resources efficiently and to avoid duplication of research activities and overlapping of research efforts. At national level, this co-ordination is the responsibility of the Ministry of Research and Environmental Affairs (MoREA). Bilaterally, DAR interacts with a number of institutions some of which are briefly discussed in the following subsections.

### 2.4.1 University of Malawi

Three institutions under the general administration of the University of Malawi conduct research directly connected to crops, livestock and rural development. These are Bunda College, Chancellor College, the Polytechnic and Centre for Social Research.

#### Bunda College of Agriculture

In addition to producing most of the scientists employed in the DAR, the college has the mandate of doing some of the research work on the common bean i. e., disease and insect control, intercropping patterns and culinary aspects. Through research programmes with DAR, scientists at Bunda College tap upon the financial, physical and human resources of DAR.

Apart from research on common beans, scientists at Bunda College collaborate with DAR on sunflower programme, sorghum/millet programme and general food legumes; vegetables, livestock/pastures research and the nutritional evaluation of livestock feeds. All research on pigs/swine is carried out by Bunda.

#### Chancellor College and The Polytechnic

The Departments of Biology and Chemistry at Chancellor College have been working together with DAR scientists on cassava mealybug, soil pests and cassava detoxification projects. The Centre for Social Research has been utilised in carrying out social research related to agricultural and rural development. The Polytechnic is involved in the development of farm equipment.

The University has been the major beneficiary of DAR's contract Research Programme under NARP. Several research contracts were awarded to University scientists. These were on indigenous fruits and vegetables, milk production in goats and sheep, mealybug on cassava, and estimation of farm enterprise budgets. The involvement of the University as a direct research support organisation to DAR makes very effective use of Malawi's human resources.

### 2.4.2 The Agricultural Research and Extension Trust (ARET)

Tobacco is the biggest foreign exchange earner for Malawi. Research on the crop was originally done by DAR at Chitedze and Mwimba Research Stations. Through recognition of the important role of the crop and the need for more research results to emerge from the programme, the government decided to create a statutory institute to focus on tobacco research requirement which later became a private institute known as Tobacco Research Institute of Malawi (TRIM). TRIM also co-operated with DAR on Agro-forestry research activities and the use of DAR's facilities for soil analysis. Early in 1995, TRIM and a sister body, the Estate Extension Service Trust, merged to form one organisation called the Agricultural Research and Extension Trust (ARET).

The Trust will continue to conduct research on all types of tobacco and to provide extension services to the estate sector. It is envisaged that ARET will co-operate with DAR in its efforts to promote crop diversification on the estates. The Principal Secretary for Agriculture and Livestock Development is a Board member of ARET.

#### 2.4.3. **Tea Research Foundation of Central Africa (TRF)**

The Tea Research Foundation of Central Africa (TRF) is one of the oldest research institutions in Malawi as well as in Southern Africa and Tanzania. The organisation conducts all research on tea for Malawi. Though privately-owned and funded, the results of research work on tea are made available to smallholder farmers growing tea. Interaction with TRF has been through the awarding of research contracts and representation on the Board of TRF and also the representation of TRF on several committees of DAR. For example, TRF was awarded a contract by DAR to establish a coffee research facility to determine a sound basis for improvements in both estate and smallholder farming sectors. The coffee contract research has so far been the largest single contract awarded by DAR. DAR also awarded a contract to the TRF on irrigation research project for tea plantations. The scientists working on coffee at TRF form part of the national coffee research team. DAR staff are occasionally seconded to TRF to work together with TRF staff. TRF has maintained itself as a relatively small organisation, but well-established and advanced in its research activities.

#### 2.4.4 **Department of Animal Health and Industry (DAHI)**

This Department provides veterinary services to the smallholder farmer, carries out research on animal diseases and is also engaged in livestock production and marketing. Since DAR also carries out research on livestock, co-ordination with this department is necessary for better planning of activities pertaining to livestock to avoid duplication in livestock research. DAR and DAHI are frequently represented on each other's committees that relate to livestock research and development in general.

#### 2.4.5 **Forestry Research Institute of Malawi (FRIM)**

The Forestry Research Institute of Malawi (FRIM) is under the Ministry of Natural Resources and concentrates its research on forestry. DAR's Agroforestry Commodity Team collaborates with FRIM in various research activities.

#### 2.4.6 **Sugar Research**

Research on sugar is conducted by Sugar Corporation of Malawi (SUCOMA) and Dwangwa Sugar Corporation (DWASCO). Interaction with DAR is mostly during introduction of new varieties where DAR's quarantine facilities are used. A quarantine facility at Bvumbwe Research Station has been funded by SUCOMA.

#### 2.4.7 **The Department of Agricultural Extension and Training (DAET)**

DAR's researchers collaborate with DAET in conducting on-farm testing and adaptation trials of technologies developed at research stations. In this way, DAR's scientists are able to identify, at the spot, hitherto unknown technical and socio-economic problems faced by farmers. This helps the scientists to define farmers' problems more precisely and to refocus their research programmes accordingly. Furthermore, this approach accords DAR's scientists with the opportunity to directly interact with farmers thereby strengthening the farmer-extension-researcher linkages. DAET is also an active member of many committees in DAR.

#### 2.4.8 **The Land Husbandry Branch**

The Land Husbandry Branch is under the umbrella of DAET. DAR interacts with the Unit in developing technologies for land use and environmental conservation systems.

#### 2.4.9 **The Food and Nutrition Unit**

The Food and Nutrition Branch was established within the Ministry of Agriculture and Livestock Development to serve as a supporting and complementary service to all agricultural services. DAR collaborates with the Unit in areas of processing, utilisation and storage of food and livestock products.

#### 2.4.10 **The Department of Irrigation**

This department is within the Ministry of Irrigation and Water Development. DAR interacts with this department in developing irrigation-based technologies.

#### 2.4.11 **The Planning Division**

This division falls under the umbrella of the Ministry of Finance, Economic Planning and Development. The Planning Division in the MoALD is responsible for collecting data on Malawi's agricultural sector for planning purposes. The DAR interacts with this division in tapping on the data for planning purposes. In addition, DAR utilises this division in the formulation of projects for funding.

services. The Ministry of Agriculture and Livestock Development, apart from hosting some of SACCAR networks/projects such as the SADC/ICRAF Agroforestry Project, SADC/ICRISAT Groundnut Project and the SADC/IITA - SARRNET, is a member of the Board of SACCAR. SACCAR has been instrumental in promoting linkages among the NARs of SADC.



## CHAPTER 3

### GOALS, CONSTRAINTS AND OBJECTIVES OF COMMODITY RESEARCH AND SERVICES GROUPS

#### 3.1 AGRICULTURAL RESEARCH GOALS

The goals of DAR are to develop crops and livestock technologies that will promote increased crops' and livestock production, and to develop a systematic and comprehensive information management system that will provide information on technologies that can be utilised by all farmers to solve technical production problems.

#### 3.2 RESEARCH CONSTRAINTS

##### 3.2.1 Environment

Malawi's agricultural production is largely dependent on rainfall which is characterised by frequent droughts and heat stress. These increase risks of crop and livestock failure. It is estimated that about 5.8 % of arable land is suitable for irrigation development but only 0.3 % is under irrigation. Thus, there is scope for increasing the hectareage under irrigation.

In order to reduce the adverse effects on crops and livestock production from these environmental constraints, DAR should:

- develop crop varieties and livestock breeds that are resistant/tolerant to drought and heat stress;
- develop technologies for soil and water conservation;

Also, and most importantly, the Government of Malawi must be committed to expand the irrigable hectareage.

##### 3.2.2 Pests and Diseases

Pests and diseases reduce crop and livestock production, especially with the inherent environment conducive to their proliferation. This situation is worsened by the unchecked use of pesticides and other agrochemicals most of which are banned in their countries of origin. Research in these areas is required to minimise crops and livestock losses, and damage to the environment by:

- developing crop varieties and livestock breeds resistant/tolerant to pests and diseases;
- developing environment-friendly pest control technologies.

##### 3.2.3 Population Growth and Pressure on Land

By mid 1994, Malawi had an estimated population of about 10 million people with a growth rate of 3.3% per year. It is estimated that the population will be 12 million by the year 2000. Thus, population pressure on land becomes evident. There is little opportunity for fallowing and rotation to restore soil fertility and conservation. Farmers have consequently expanded their cultivation to marginal, less fertile areas often on hill slopes which are not suitable for intensive cultivation. Inevitably, this expansion has led to rapid depletion of woodland, soil degradation and erosion. Efforts are, therefore, required to increase productivity on the available land.

##### 3.2.4 Policy and Institution

Malawi is a land-locked country with a poor rural road network hence problems of transportation and distribution of agricultural inputs and outputs are major limiting factors to increased agricultural production. Consequently, agricultural produce has uncompetitive prices on the export markets. This is exacerbated by uncompetitive prices for agricultural commodities and inadequate marketing arrangements. The GoM's policy of liberalised markets for both goods and services is aimed at producing a competitive and rewarding environment for all agricultural products.

It is, therefore, necessary that agricultural policy issues reflect the existing and ever changing economic realities in order to create an enabling environment for farmers to adopt and utilise production technologies developed by researchers in DAR. This would result in increased crops and livestock production which is necessary for the development of a strong agro-industrial base.

##### 3.2.5 Inadequate Financial Resources

The level of investment in DAR is very low (about 0.5 % of Agricultural GDP in 1992-93). With the advent of crop/livestock diversification and poverty alleviation themes, more resources are needed to expand the generation and modification of research technologies in order to directly benefit both the resource-poor and estate farmers. Technologies will need to be of low cost but appropriate and of high quality. Similarly, approximately 80-85% of farmers have a low economic capacity and credit facilities are also inadequate. New technologies can only be disseminated to the farming community if credit facilities are accessible. Funding for research activities is inadequate thus limiting the development of such technologies. The proposal put forward in this Master Plan is to raise the investment in research by more than 100% to above 1% of the agricultural GDP in real terms by the year 2000.

### 3.2.6 Human and Technical Resources

There is a shortage of trained manpower to sustain crops and livestock research. The problem is exacerbated by high brain drain the Department has had due to poor incentives culminating in low morale, among others. The advancement of scientists in their career path is lacking. Also, the process of recruiting new staff to replace those retiring and the filling of vacant posts are slow. The ideal situation is to have two scientists per discipline. Replacement of vacated posts is very slow resulting in overworking and frustrating the remaining scientists. This is particularly true for technical and support staff specialised personnel for maintaining scientific equipment, food scientists and horticulturists among others. Opportunities for short term courses to upgrade on specific jobs are not as many as desired. Bureaucratic barriers prevent most of the nominees to proceed for training. Lack of adequate specialised facilities and equipment has resulted in slow generation of technology in certain commodities. There is a need to improve the planning, evaluation and co-ordination of manpower and infrastructure requirements of the department.

## 3.3 RESEARCH STRATEGY

The research strategy of DAR is largely to conduct applied and on-farm research which provides solutions to the technical and socio-economic problems facing producers of food and cash crops as well as livestock. Such research will be planned and executed according to approved national research priorities which will be clearly approved by the ARC. The research strategies are as follows:

- (a) developing high yielding varieties which are tolerant or resistant to pests and diseases for food and cash crops, pastures and livestock;
- (b) developing appropriate cultural practices and integrated pest management systems for all crops, pastures and livestock to sustain optimum yields. Also developing appropriate multiple cropping system combinations for cereals, legumes, root and tuber crops, pastures, and different species of livestock enterprises for optimum yield and conservation of resources;
- (c) developing labour-saving technologies;
- (d) increasing stability of agricultural production by developing varieties of crops which are tolerant to drought and resistant to pests and diseases and livestock breeds of wider adaptation;
- (e) developing agro-ecological zone specific recommendations for crops, pastures and livestock;
- (f) developing methods of controlling soil erosion and fertility loss;
- (g) developing irrigation technologies to increase crop, livestock and fish production;
- (h) developing technologies that would lead to crop and livestock diversification; and
- (i) developing and promoting technologies for natural resource conservation.

## 3.4 RESEARCH AND SERVICES COMMODITY GROUPS

The government policy aims at a balanced and diversified production of crops and livestock to meet the country requirements for food, cash crops for foreign exchange, higher rural incomes and maintenance of natural resources. To achieve this policy, there is need for research to address the existing constraints with clearly defined objectives for each commodity. DAR is, therefore, organised into five commodity and two service groups to address the specific problems. Emphasis is also placed on developing the technical and socio-economic analysis of farming systems, effective dissemination of findings and assessment of the impact of services on the farming community.

The goals outlined under each commodity or service group reflect the desired national aims and policies. The five commodity research and two service groups are as follows:

### 3.4.1 Cereals

Maize, rice, sorghum, millets and wheat cereal crops are important sources of carbohydrate for the large proportion of the Malawi population. They are predominantly smallholder crops and the overall goal of the DAR is to develop improved and affordable production technologies for increased food production and availability to achieve food self-sufficiency at the national level and to improve food security at the individual household level. Goals, key constraints, research objectives and expected impacts specific to each of the 4 commodities are spelt out below.

#### 3.4.1.1 Maize

Maize is the most important food crop in Malawi grown throughout the country. In 1992/93, it was estimated that a total area of 1.33 million hectares was planted to maize yielding a total of 2.03 million tonnes or an average of 1.53 tonnes per hectare which is very low. The major constraints to increased maize production are use of low yielding local varieties by the majority of farmers; inadequate fertiliser application and low soil fertility; and poor crop management practices.

## Goal

To increase yields of maize per unit area in order to attain and maintain self-sufficiency at the individual household level and at the national level. This might consequently release land for cash and other food crops diversification.

## Constraints

(maize)

- 1 (a) the frequent occurrence of mid-season drought conditions and diseases;
- 2 (b) the short growing season and erratic rainfall distribution and heat stress; occurrence of maize streak virus disease in the low-altitude zones;
- 3 (c) high costs of inputs such as seed, fertilisers, chemicals and labour for the resource-poor farmer to grow high yielding hybrid varieties;
- 4 (d) low soil fertility, and inadequate amounts of fertilisers purchased and applied to the potentially high yielding varieties among the moderate to resource-poor farmers;
- 5 (e) poor agronomic and cultural practices by most smallholder farmers (late planting, late application of basal and top dressing fertilisers, late and inadequate weeding);
- 6 (f) high incidence of witchweed (*Striga* Spp.) in some major maize growing areas;
- 7 (g) shortage of labour force during peak labour demand, and lack of labour saving technologies for the majority of farmers, especially women; and
- 8 (h) inadequate number of high yielding and early maturing varieties.

## Research Objectives

- (a) maintain, improve and manipulate breeding stocks in order to develop high yielding and early maturing hybrids (either white semi-flint, flint or dent seeded hybrids), composite and synthetic varieties with a range of traits suitable for both smallholders and estate farmers;
- (b) develop and maintain a germplasm bank with materials of diverse origin for inbred lines development, and development of composite and synthetic varieties for resource poor farmers;
- (c) develop varieties for tolerance or resistance to maize diseases and insect pests (streak virus, *Puccinia polysora*, *P. sorghi*, *Helminthosporium turcicum* and *H. maydis* diseases, stalk borer, termites, etc.); drought and heat stress;
- (d) develop maize varieties adapted for tolerance to low soil fertility and witchweed;
- (e) investigate the response of recommended and experimental maize varieties to different fertility levels, mixed cropping systems and plant densities to fit smallholder capability;
- (f) improve fertiliser use efficiency through proper rates for each agro-ecological zone, proper placement, timely weeding, timely application and proper fertiliser mixes;
- (g) determine labour-saving technologies for fertiliser placement and weed control;
- (h) investigate alternatives to inorganic fertilisers, including farm yard manure, legume green manures, crop residues, and determine the interactions between inorganic and organic fertilizer. Also investigate other nutrients that limit maize production other than nitrogen and phosphorus;
- (i) integrate maize into various cropping systems such as intercropping with nitrogen fixing legume crops, agro-forestry systems and rotation to increase maize yields and improve soil fertility; and
- (j) develop suitable cultural practices for dimba maize production in the winter (time of planting, fertiliser rates, soil water conservation, population densities).

## Expected Impact

Increased availability of high yielding semi-flint and composite/synthetic maize varieties; increased availability of improved management practices; reduced soil fertility degradation; increase maize production per unit area.

### 3.4.1.2 Rice

Rice, as a cereal food crop, ranks second to maize. It is cultivated as an irrigated crop on about 3,586 hectares and as a rainfed crop on 30,000 hectares in some plains of lakes Malawi, Chilwa and Malombe and along the Shire River and in Phalombe Plains at altitudes ranging from less than 50 metres above sea level to 900 metres above sea level. Of the total cultivated area, 86% is rainfed and 14% is irrigated. There is potential to double the cultivated area and consequently expand rice production.

The average yield of rice obtained by smallholders is 2.8 t ha<sup>-1</sup> while that obtained by researchers ranges from 4 to 6 t ha<sup>-1</sup>. Low yields are a result of growing traditional low yielding, tall and late maturing photo-period sensitive varieties and poor agronomic practices.

## Goal

To increase rice production through increased grain yields per unit area and increased cultivation of rainfed and irrigated area to meet the domestic demand and for exports.

## Constraints

- (a) lack of high yielding rainfed varieties (upland and mid altitude varieties), consumer-acceptance and temperature tolerant varieties;
- (b) susceptibility to blast (*Pyriculariae oryzae*) and brown spot (*Cochliobolus meiyabeanus*) diseases of current recommended varieties;
- (c) unavailability of small-scale field and post-harvest machinery;
- (d) dependence on rain-fed rice production;
- (e) suboptimal amounts of fertiliser application;
- (f) late and inadequate weed control coupled with poor irrigation water management practices;
- (g) late planting and fertiliser application;
- (h) lack of resources to purchase farm inputs; and
- (i) low milling yields.

## Research Objectives

- (a) introduce and select or breed high yielding varieties of good milling qualities; acceptable eating qualities and appropriate growth characteristics suitable for either rainfed or irrigated growing environments;
- (b) develop early maturing (125-130 days) varieties to escape end-of-season soil moisture stress in rainfed areas and tolerance to drought;
- (c) develop varieties resistant or tolerant to brown spot (*Cochliobolus miyabeanus*) and blast (*Pyriculariae oryzae*) diseases;
- (d) investigate rice-based cropping systems to improve soil fertility, control weeds, pests and diseases;
- (e) determine appropriate cultural practices for the rainfed and irrigated rice crops;
- (f) to develop and determine labour-saving technologies for rice production (land preparation, weed control, fertiliser application, planting or transplanting methods, harvesting, threshing.);
- (g) to determine optimal and affordable fertiliser rates and mixes for various agro-ecological zones; and
- (h) to determine alternative crops for production in rice schemes to widen the range of food and cash crops for diversification.

## Expected Impact

Increased availability of high yielding and consumer-acceptable varieties; increased availability of improved cultural practices including soil fertility; increased production per unit area; and increased food security and nutrition status for the smallholders and the population as a whole.

### 3.4.1.3 Wheat

Wheat is grown in the dry and cool highlands of Malawi. However, production is constrained by inadequate seed of improved varieties; soil moisture, temperature and disease stresses and poor agronomic practices.

## Goal

To increase production and availability of wheat to meet the domestic demand for wheat and wheat products.

## Constraints

- (a) lack of suitable wheat varieties (early maturing, disease/pest tolerant/resistant and high yielding varieties) for rainfed and irrigated environments;
- (b) inadequate soil moisture and high temperature stresses, pests and diseases;
- (c) poor cultural practices; late planting, late weeding, late fertilizer application, and inadequate fertiliser application;
- (d) low price of wheat in relation to cost of inputs; and
- (e) lack of simple implements for farm operations and post-harvest processing.

## Research Objectives

- (a) introduce and select high yielding varieties with wide range of adaptation, resistance to major diseases and pests; and suitable grain quality for processing wheat-based product;
- (b) determine appropriate cultural practices for both the smallholder and estate farmers' cropping systems under irrigated and rainfed conditions;

- (c) study the phenology and physiological processes of wheat in relation to the environmental factors that limit production in Malawi;
- (d) determine appropriate soil and water conservation practices;
- (e) determine irrigation frequencies, water and fertiliser requirements for various agro-ecological zones for irrigated wheat; and
- (g) determine sustainable wheat-based multiple cropping systems to increase wheat yields and improve soil fertility.

#### Expected Impact

Increased availability of improved wheat varieties; improved cultural practices and increased wheat production.

#### 3.4.1.4 Sorghum and Pearl Millet

Sorghum and pearl millet are the most important cereals for approximately 1 million people living in the very dry areas of Malawi where maize is poorly adapted. However, increased production of these crops is constrained by the growing of unimproved late maturing and low yielding varieties, disease and insect/pest incidence, and poor agronomic practices.

#### Goal

To increase sorghum and millet production and utilisation, particularly in the semi-arid areas and promote the production of these crops to similarly drought stricken areas so as to increase and maintain food security.

#### Constraints

- (a) insufficient improved varieties that are short season, high yielding and of acceptable grain quality for food and brewing;
- (b) poor agronomic management practices (late planting; late and inadequate weeding, low plant population);
- (c) high field and storage grain losses (up to 90%) due to field insect pests, birds and weevils; and
- (d) poor soil and water conservation practices.

#### Research Objectives

- (a) continue collection of local sorghum germplasm so as to maintain and preserve a working germplasm base with materials of diverse origin as breeding populations to generate line cultivars or lines for hybrid varieties;
- (b) develop high yielding white-seeded sorghum varieties with hard endosperm for food; white-seeded sorghums with soft endosperm and low polyphenol content for lager beer and brown-seeded sorghums with soft endosperm with high polyphenol content for brewing opaque beer;
- (c) develop and select a wide range of varieties to promote diversification of these crops into other agro-ecological zones and increase food security;
- (d) maintain and multiply breeders' seed for supply to seed production organisations;
- (e) develop appropriate cultural practices and inputs packages for sole cropping and intercropping systems of sorghum and millets with other crops; and
- (f) develop integrated insect, disease and weed management methods.

#### Expected Impact

Increased availability of short season and high yielding sorghum and millet varieties; increased availability of improved agronomic practices; increased yields; increased availability of IPM packages/technologies; reduced cultivation of maize in environments that are unsuitable for maize production.

#### 3.4.2. HORTICULTURE

Malawi has ideal conditions for the production of a wide range of horticultural crops with both domestic and export market potential. Vegetables and fruits increase the variety of basic foods in addition to being good sources of income. The horticultural industry is under-developed and this masks its importance to the nation. There is high scope for expansion of the industry to fulfil some of the demand for horticultural products at both domestic and international markets and contribute towards crop diversification.

##### 3.4.2.1. Citrus and Deciduous Fruits

The major citrus fruits are oranges, lemons, grapefruits and tangerines, while the important deciduous fruits are apple, peach, plum, grapes, and strawberry. The full potential of these fruits has not been exploited, and statistics on production areas under citrus and deciduous fruits are not available.

## Goals

To increase production and improve quality of citrus and deciduous fruits.

## Constraints

- Citrus & deciduous* (1)
- insufficient number of adaptable, high yielding and good quality varieties;
  - lack of adapted rootstocks resistant to soil pests, diseases, water logging or water stress;
  - lack of post-harvest handling technologies which leads to losses in both quality and quantity;
  - insufficient supply of planting material; and
  - inadequate horticultural training for extension workers and farmers on tree training, pruning and supplementary irrigation.

## Research Objectives

- improve the range and quality of fruits being grown locally;
- develop appropriate technologies and practices for production of selected fruits;
- develop fruit tree nutrition technologies for high altitude areas;
- improve the use of live and dry mulch to conserve soil and water in fruit orchards;
- develop appropriate harvesting and post handling technologies and practices;
- develop technology for economic control of pests and diseases;
- establish on-farm trials and demonstrations in farmers' fields and farmers' training centres; and
- encourage seed production by private entrepreneurs.

## Expected Impact

Increased production of high quality fruit at both subsistence and commercial level. The country will also benefit from diversification of its agriculture to ensure sustainability of production and productivity of land.

### 3.4.2.2 Tropical Fruits and Spices

Major tropical fruits include mango, avocado pear, banana, guava, papaya and pineapple, while the spices of importance are chilies, ginger and turmeric. The climatic conditions in Malawi are ideal for producing these tropical fruits and spices but the potential is not fully exploited.

## Goal

To increase production of the major tropical fruits and spices to satisfy both the local and export market demand and promote crop diversification.

## Constraints

- Tropical Fruits and Spices* (2)
- insufficient availability of good quality and high yielding varieties;
  - lack of post-harvest handling and storage technology which leads to high quality losses;
  - yield loss due to incidences of pests and diseases;
  - inadequate supply of fruit trees for fruit growers;
  - lack of horticultural training manuals for extension personnel and farmers on fruit orchard management; and
  - inadequate experts in horticulture in the country.

## Research Objectives

- collect, introduce and evaluate germplasm of mango, avocado pears and bananas to increase the range of available varieties and screen them for resistance to diseases;
- improve yield and quality of tropical fruits and spices by introducing new types and developing their appropriate production technologies for use by growers;
- develop technology for economic control of pests and diseases;
- evaluate fruit and spice varieties for processing;
- evaluate mango rootstocks for utilization of non-arable land; and
- establish data base on production of fruits and spices.

## Expected Impact

Enhancement and expansion of the fruit industry in Malawi for local and export markets backed by appropriate technologies and crop diversification.

### 3.4.2.3. Tree Nut Crops 3

The major tree nut crops are macadamia and cashew while coconut and oil palm trees are just being introduced. These crops have considerable potential for diversification of Malawi's sector as foreign exchange earners and as cash crops for the smallholder sector.

Research will emphasize on improving cashew and macadamia varieties in order to encourage increased production of these crops to meet both local and export demand.

#### Goals

Increase and sustain the production of high quality nuts, improve nutrition and incomes of the rural population and the private sector.

#### Constraints

- (a) lack of high yielding adaptable varieties, especially of cashew;
- (b) pests and diseases including the bugs on macadamia and the mosquito bug on cashews which cause considerable damage;
- (c) high temperatures and inadequate rainfall; and
- (d) poor agronomic and cultural practices.

#### Research Objectives

- (a) introduce, select and evaluate high yielding varieties of macadamia and cashew nuts;
- (b) develop an integrated pest management system to control major pests and diseases;
- (c) improve harvest and post-harvest handling and processing of macadamia, cashew nuts, coconuts and palm oil trees;
- (d) monitor tree nutrition status and nut quality;
- (e) improve cultural practices including nutrition and tree size control; and
- (f) disseminate research findings and recommendations through farm visits, demonstration plots, training courses and publications.

#### Expected Impact

Increased farmers' income and foreign exchange arising from improved and increased macadamia, cashew, coconut and oil palm production; increased crop diversification.

### 3.4.2.4. Coffee 4

Currently, there are about 9,000 smallholder families, mainly in the Northern Region where the smallholder coffee production is concentrated, who depend on coffee as a source of income. Coffee is also grown successfully in the Southern and Central Regions by estates. There are about 3800 hectares under smallholder coffee in Malawi and this is expected to increase with more research effort to control coffee berry disease. Research on coffee has concentrated on variety improvement, disease control and the development of suitable agronomic practices.

#### Goals

To increase coffee production through the control of diseases, the releasing and planting of new varieties, and the rehabilitation of the existing coffee plantations.

#### Constraints

- (a) lack of adaptable cultivars;
- (b) poor distribution of rainfall in coffee growing areas;
- (c) poor cultural practices such as fertiliser application, irrigation and mulching requirements; and
- (d) destructive pests and diseases including coffee berry disease, leaf miners and coffee leaf rust.

#### Research Objectives:

- (a) assess chemicals for the control of coffee berry disease and leaf rust disease;
- (b) introduce and evaluate varieties for yield and resistance to the major diseases such as coffee berry disease and leaf rust disease;
- (c) improve agronomic practices to suit smallholder farmers;
- (d) evaluate the role of agroforestry in coffee production since coffee needs shade trees; and
- (e) investigate the suitability of intercropping coffee with other crops to effectively utilise land.

### Expected Impact

The production of coffee will increase the income of people in the rural areas, whose major source of income is coffee.

#### 3.4.2.5 Vegetable Crops and Mushroom <sup>(5)</sup>

Vegetables are important in the diet of the people because they are a major source of vitamins. They also supplement proteins and carbohydrates in the diet. Vegetables are produced for home consumption as well as for cash income. Research in Malawi, has concentrated on developing or introducing improved varieties of onion, tomatoes, shallots, garlic, snap beans, cabbage, kale, mustard, hot peppers, asparagus, capsicum, okra and muskmelon. Studies on appropriate production technologies for these crops are being conducted.

#### Goal

To increase production and utilisation of both indigenous and exotic vegetables throughout the year.

#### Constraints <sup>(5)</sup> *Vegetables* <sup>(6)</sup>

- (a) limited availability of high yielding, adaptable varieties;
- (b) high incidence of pests and diseases;
- (c) poor soil fertility and cultural practices;
- (d) limited sources of high quality seeds;
- (e) lack of post-harvest technology; and
- (f) lack of marketing infrastructure and support for vegetable growers.

#### Research Objectives

- (a) screen and select improved vegetable varieties and develop suitable cultural practices for smallholder farmers
- (b) develop a vegetable seed production capability;
- (c) evaluate alternative sources of nutrients to increase vegetable production; and
- (d) develop post-harvest handling practices appropriate for smallholder farmers.

#### 3.4.2.6 Fruit Nursery Improvement

The Government of Malawi has recognised the importance and potential of horticulture in promoting crop diversification, improving human nutrition, income generation, creating employment and generating foreign exchange. There are many fruit types that can successfully grow in Malawi. But fruit production is still very low compared to the potential because of several constraints. One of these constraints is the unavailability of affordable planting materials.

#### Goal

To increase the availability, to the farming community, of good quality planting material of recommended fruit varieties in order to promote the contribution of horticulture to the country's economy and contribute towards food self-sufficiency.

#### Constraints

- (a) limited financial support from the Government to horticultural research stations for development of nursery activities since it is not a research activity;
- (b) absence of private nursery establishments in the country which makes it difficult for farmers to have access to good quality plant material; and
- (c) paucity of farmers' knowledge about the availability of improved varieties of plant material in Malawi of different fruit types adapted to different ecological zones in the country.

#### Objectives

- (a) develop nursery facilities throughout the country so as to make available, to the community, good quality plant material of recommended fruit varieties at affordable prices;
- (b) develop appropriate technologies for fruit plant propagation and nursery management practices; and
- (c) develop a training programme to teach farmers and the interested people different aspects of nursery management in order to encourage private individuals to establish nurseries.

#### Expected Impact

Increased growing and production of fruit crops of different types and increased crop diversification.



- (b) inadequate supply of and expensive certified seed;
- (c) poor cultural practices;
- (d) poor rainfall distribution;
- (e) poor soil properties;
- (f) labour intensiveness; and
- (g) inadequate technologies for processing and utilisation.

#### Research Objectives

- (a) develop disease-resistant varieties with desirable agronomic and quality characteristics;
- (b) devise a good seed production scheme which will ensure adequate availability of and less expensive seed to the farming community;
- (c) develop good cultural practices;
- (d) develop stress-tolerant varieties for ecologies with low rainfall and fertility; and
- (e) develop post-harvest technology that would minimise labour use.

#### Expected Impact

More high yielding disease resistant varieties with better seed and oil quality; improved cultural practices resulting in increased crop production; increased seed yield per unit area; more cash income for the smallholders; and increased volume of agro-industries for both confectionery and oil processing.

#### 3.4.3.2. Beans

Beans are one of the most popular and important food legumes in Malawi. They are grown widely in upland areas (between 450 - 1300 m.a.s.l) as either intercrops with maize or as a relay crop after the intercrop and as a dimba crop in winter. In Malawi, beans have the potential to produce grain yields in excess of 3000 kg per ha in pure stand. However, present farm production levels are at 200 kg ha<sup>-1</sup> and 600 kg ha<sup>-1</sup> grain in intercropping and pure cropping systems, respectively.

#### Goal

To promote bean production and utilisation.

#### 8 Constraints

- Beans*
- (a) susceptibility of available varieties to angular leaf-spot, halo blight, common bacterial blight, web blight and rust; pests such as bean-fly (bean stem maggot) and bean beetle in the field, and bruchids in storage;
  - (b) low soil fertility;
  - (c) poor cultural practices employed by farmer;
  - (d) lack of drought-tolerant bean varieties;
  - (e) inadequate seed supplies of recommended bean varieties; and
  - (f) low grain yields.

#### Research Objectives

- (a) breed high yielding bean varieties that will combine high consumer acceptance in terms of grain qualities and tolerance to major bean pests and diseases and other abiotic stresses;
- (b) develop suitable cultural practices that will enable increased bean production under various cropping systems suitable for the smallholder farming systems;
- (c) assist in technology transfer to the farming community; and
- (d) assist in developing a comprehensive bean seed multiplication and distribution schemes in the country.

#### Expected Impact

Increased bean production; increased availability of seeds of high yielding cultivars; improved and more appropriate production technologies for bean production.

#### 9 3.4.3.3 Soya beans

Soya beans are becoming an important food legume crop in Malawi as a source of high quality protein diet for both human and animal nutrition; soya beans are also a source of cash income to the smallholder and the estate sector; as an intercrop with crops such as maize, they provide a strategy for crop diversification, food security and soil fertility replenishment. Soya beans are also used for vegetable oil expression. Production potential of soya beans are in excess of 3000 kg ha<sup>-1</sup>. However, current farmers' yields are below 1000 kg ha<sup>-1</sup>. The major production constraint include inadequate seeds and poor cultural practices.

**Goal**

To increase the hectareage under soya beans. This will in turn spur more soya bean utilisation in the home and the industries.

**Constraints** *Soybeans*

- (a) inadequate farmer awareness on how to process and utilize soya beans;
- (b) inadequate amounts of quality seeds of the recommended cultivars;
- (c) lack of varieties with resistance to root-knot nematodes;
- (d) lack of varieties with tolerance to drought;
- (e) poor capability to self-nodulate in the current recommended varieties;
- (f) poor crop management practices;
- (g) short shelf life of seeds of current varieties; and
- (h) insufficient rhizobium inoculant production facilities.

**Research Objectives**

- (a) develop high yielding varieties;
- (b) develop varieties with long seed viability;
- (c) develop root-knot nematode resistant varieties;
- (d) develop self-nodulating varieties that give optimum yields;
- (e) develop appropriate cultural practices;
- (f) identify more efficient rhizobium inoculant;
- (g) assist in developing technologies in processing and utilisation;
- (h) increase in technology transfer; and
- (i) assist in developing a sustainable seed production and distribution system.

**Expected Impact**

Increased soya bean production, processing and utilisation by the rural people; increased agro-industries on soya bean-based products.

**3.4.3.4 Pigeon pea**

Pigeonpea is an important pulse accounting for 53% of total pulse production in Malawi and is widely grown for local consumption and export. Most pigeonpea is grown as an intercrop with maize, sorghum, cassava, cotton and many other crops using mostly the long duration landraces. The introduction of short duration varieties provides great potential for pigeonpea production and utilisation in the country.

The current production practices involve the use of the long duration cultivars of pigeonpea mainly as an intercrop with maize, sorghum, cassava and cotton. Apart from ICP9145 other long duration cultivars are susceptible to Fusarium wilt disease and mature late during the dry season. The introduction of short duration cultivars has opened up new vistas for pigeon pea production using different farming systems both by the smallholder and estate sector.

**Goal**

To increase pigeonpea production, processing and utilisation.

**Constraints** *Pigeonpea*

- (a) lack of early maturing, high yielding and Fusarium wilt disease resistant varieties;
- (b) poor cultural practices;
- (c) inadequate amounts of seeds of the recommended cultivar ICP 9145;
- (d) high incidence of fusarium wilt disease and other diseases such as bacterial stem canker, leaf spots, root-knot nematodes and collar rot;
- (e) lack of information on the various methods of processing and utilisation; and
- (f) high incidence of insect pests including pod borers and sucking insects.

**Objectives**

- (a) develop high yielding varieties with good quality seed characteristics;
- (b) develop varieties with resistance to Fusarium wilt disease;
- (c) develop varieties with multiple harvests;

- (d) develop varieties for intercropping;
- (e) develop improved cultural practices;
- (f) assist in developing a seed multiplication and distribution scheme;
- (g) assist in technology transfer; and
- (h) develop technologies for processing and utilisation both at home and industry level.

### Expected Impact

Increased pigeonpea production, processing and utilisation

#### 3.5.3.5 Cowpeas

Cowpeas provide a good quality vegetable protein for human consumption as well as livestock. Although the crop is grown throughout the country, it is mostly favoured in the warmer and drier parts of the country. It is planted either as an inter-crop with maize, sorghums, cotton, cassava and many other crops or as a dimba crop in the dry season. Currently, the potential production levels of 2000 kg ha<sup>-1</sup> are not being realised due to disease and insect pests, poor cultural practices, and lack of seeds of improved varieties.

### Goal

To increased cowpea productivity.

### Constraints

- Cowpeas*
- (a) neglected status of the crop;
  - (b) insufficient high yielding cultivars of acceptable grain quality and dual use;
  - (c) inadequate supplies of seeds of the improved variety Sudan 1;
  - (d) high incidence of diseases such as zonate leaf spots and cowpea mosaic virus (CMV), and susceptibility to insects and pests; and
  - (e) poor cultural practices.

### Research Objectives

- (a) develop early, medium and long-duration cowpea varieties with high yield potential and acceptable seed qualities;
- (b) develop improved varieties with resistance to Ascochyta blight disease and insect pests;
- (c) develop varieties for both grain and leaf yield;
- (d) develop improved cultural practices;
- (e) develop technologies for processing and utilisation;
- (f) assist in developing a seed multiplication and distribution scheme; and
- (g) assist in technology transfer.

### Expected Impact

Increased production and utilisation of cowpeas.

#### 3.4.3.6 Chickpea

Chickpeas are an important legume crop in some parts of the country as a source of high protein food for human nutrition particularly the Asian community. Chickpeas are produced mainly by the smallholders as a relay crop after maize. Current production is very low (less than 500 kg per ha<sup>-1</sup>), a result of lack of improved varieties, disease and insect pests, and poor cultural practices. However, there is high demand for the crop, especially for the export market.

### Goal

To increase chickpea production, processing and utilisation for both local and export demand.

### Constraints

- (a) lack of improved varieties;
- (b) high disease and insect pest incidence;
- (c) poor cultural practices; and
- (d) unavailability of high quality seed.

### Research Objectives

- (a) develop improved varieties with acceptable seed qualities and resistance to diseases and insect pests;
- (b) develop improved cultural practices; and
- (c) assist in technology transfer.

#### 3.4.3.7 Groundbean, mungbean, fababean, lentils and winged bean

Mungbeans are important legume crops in some parts of the country. These are grown mainly as a relay crop after maize for local consumption and sale to the Asian community. Fababeans, lentils and wingedbeans are being introduced into the country and are potential crops. Groundbeans are grown in most parts of the country as a source of protein for human nutrition. Future research on these crops will concentrate on the evaluation of both local and introduced germplasm for general adaptation and grain yield potential.

#### Goal

To promote the production and utilisation of these legume crops to meet existing local and export markets.

#### Constraints

- (a) neglected status of the crops;
- (b) lack of improved high yielding cultivars;
- (c) suboptimal cultural practices; and
- (d) unattractive producer prices.

### Research Objectives

- (a) screen local and exotic germplasm for high grain yield potential, resistance to major diseases and pests and acceptable grain qualities; and
- (b) develop suitable cultural practices.

#### Expected Impact

Increased production of these legumes, crop diversification and food security.

#### 3.4.3.8 Cotton

Cotton is the main cash earner for over 60,000 farming families in the major cotton growing areas of Malawi. The crop provides the largest source of raw materials for the textile, edible oils and animal feed industries in the country. However, production is limited by several factors, of which the major ones include insect pests and poor production practices.

#### Goal

To promote and sustain the production of high quality cotton for processing into textiles, edible oils and animal feeds.

#### Constraints

- (a) high incidences of diseases, root-knot nematodes, insects, and mites;
- (b) unsatisfactory and ineffective pest/disease control measures adopted by farmers;
- (c) high pest control inputs costs;
- (d) poor cultural practices, and few suitable varieties;
- (e) unfavourable environmental conditions; and
- (g) unattractive producer prices.

### Research Objectives

- (a) develop high yielding varieties with improved lint qualities and resistance to pests and diseases;
- (b) develop appropriate cultural practices;
- (c) develop simple but effective pesticide application techniques and sound long-term integrated pest management strategies; and
- (d) to control pests and diseases already in place.

### Expected Impact

Increased cotton production for textiles and edible oil crushing industries. Increased cash income to farmers who grow the crop.

#### 3.4.3.9 Sunflower

Sunflower is an important crop in Malawi and provides considerable amounts of raw material for edible oil industry in addition to cotton, groundnuts and soya beans. Malawi aims at developing the existing potentials for sunflower to diversify the sources of oil industry.

#### Goal

To promote the production of sunflower to meet the local demand for edible oils and animal feeds.

#### Constraints

- Sunflower*
- (a) lack of disease resistant cultivars with high grain yield and oil content (40%);
  - (b) inadequate supplies of seeds of the recommended cultivars;
  - (c) poor cultural practices;
  - (d) unfavourable environment;
  - (e) poor producer pricing policy; and
  - (f) high disease and pest incidence.

#### Research Objectives

- (a) develop appropriate cultural practices for increased sunflower production;
- (b) develop improved cultivars with high grain yield and oil content (40%);
- (c) conduct research in non-traditional sunflower growing areas for crop diversification;
- (d) conduct intercropping trials with cereals, food legumes and other crops; and
- (e) develop disease and pest control strategies.

#### Expected Impact

Increased oil expelling at farm and industrial level; provide cake as feed for livestock; increased income.

#### 3.4.3.10 Sesame

Malawi imports a very large percentage of sesame edible oil, although there is potential to produce surplus oil and cake for export. The local cultivars of sesame currently give low yields, but are capable of producing up to 1,000 kg ha<sup>-1</sup>.

#### Goal

To promote the production of sesame to meet the local demand for edible oils and animal feeds.

#### Constraints

- Sesame*
- (a) low yielding ability of available cultivars;
  - (b) poor cultural practices;
  - (c) Inattractive producer prices;
  - (d) lack of disease and pest resistant varieties; and
  - (e) lack of pest and disease resistance.

#### Research Objectives

- (a) develop appropriate cultural practices for increased sesame production;
- (b) develop improved cultivars with high grain yield and oil content (40%); and
- (c) develop pest and disease resistant varieties.

## Expected Impact

Increased crop diversification and cash incomes for farmers.

### 3.4.4 Livestock and Pastures

#### 3.4.4.1 Livestock

Malawi is not self-sufficient in livestock products because production potential of different animals and pasture species have not been realized. Livestock population is estimated at 0.8 million cattle, 0.8 million goats, 0.1 million sheep, 0.2 million pigs and 14 million poultry, and account for 7% of agriculture AGDP. Very few estates own livestock while 80% of smallholder farmers own livestock. For Malawi to be self-sufficient in animal protein, there should be an expansion on livestock production through the promotion of small livestock production such as goats, sheep, poultry, rabbits and non-conventional livestock (pigeon, guinea fowl, guinea pig) by small scale farmers for subsistence or commercial purposes. The estate sector should be encouraged to participate more in livestock production. Diversification of crops at smallholder and estate level will increase the feed resource base for livestock hence improve its productivity.

#### Goal

To expand livestock production to meet local demand and produce surplus for export evaluate animal breeds for different livestock production systems; develop nutritional and management strategies for different production systems.

#### Constraints

- (a) poor animal nutrition and wastage of feed resources;
- (b) lack of knowledge on feed recycling technologies in integrated livestock/crop/fish production systems;
- (c) low genetic potential of indigenous livestock breeds;
- (d) lack of knowledge on productivity of non-conventional livestock species;
- (e) lack of strategies for basic breeder stock supply;
- (f) lack of knowledge on livestock/crop/soil integration systems; and
- (g) high incidence of diseases and parasites.

#### Research Objectives

- (a) improve feeding and management of livestock feeds;
- (b) develop feeds based on locally-available feed resources;
- (c) develop feed recycling technologies;
- (d) improve genetic potential of indigenous livestock species by selection and cross-breeding with suitable exotic breeds;
- (e) characterise non-conventional livestock in production systems; and
- (f) determine production balances for livestock/crop/soils integrated farming systems.

## Expected Impact

Increased livestock breed resource base; increased milk and milk products, meat and meat products, hides, poultry and poultry products; increased livestock and agro-industries; and improved rural incomes.

### 3.4.4.2 Pastures

Ruminant livestock production in Malawi depends on pasture. Out of a national land area of 94,000 sq km, approximately 46,000 sq km form a major grazing feed resource for livestock. However, the total accessible grazing area is only 27,000 sq km comprising, mostly of natural grasses whose availability is seasonal and their quality is poor. Increased diversification of crops would increase feed resource base of livestock as these would supplement pastures hence increased livestock production.

#### Goal

To promote suitable management and utilisation of natural pastures browse and planted pastures by livestock.

14 **Constraint** Pasture

- (a) poor management of natural and improved pastures;
- (b) poor soil fertility;
- (c) low yielding potential and quality of natural pastures;
- (d) inadequate technology on grass/legume intercropping; and
- (e) inadequate information on insect pests and parasites on pasture.

**Research Objectives**

- (a) screen introduced and indigenous forage species for yield, quality and animal production potentials;
- (b) improve genetic potential of natural and planted pastures;
- (c) develop production packages for natural and newly planted pastures; and
- (d) develop mixed cropping systems of forage legumes to improve soil fertility and forage quality.

**Expected Impact**

Increased pasture yield and quality; reduced animal mortality and morbidity which will improve livestock productivity; improved soil fertility which will reduce environmental degradation.

3.4.5 **Soils and Agricultural Engineering**

Research on soils is fundamental to the improvement of agriculture. Without effective management of the soil-based resources, little can be achieved through breeding or crop husbandry. Soil and water are vital resources which need to be managed properly for maximum production of crops and livestock. Despite the fact that soil research in Malawi has been conducted since the early 1950s, and that commendable progress has been made, there is still a pressing need to conduct a well-co-ordinated and focused research which will benefit all farmers. While many other constraints to agriculture are being addressed by other Commodity Groups, priority research areas pertaining to soil and water-based problems are being addressed by commodity teams under this Group namely: Soil Fertility, Soil Microbiology, Soil Survey, Agroforestry, Farm Machinery, Irrigation and Drainage.

3.4.5.1 **Soil Fertility**

Many soils in Malawi are old, highly leached, degraded and are deficient in essential nutrients. Consequently, the soils have a poor physical structure and low-water holding capacity. This is exacerbated by the growing human population which is increasing the pressure on land. The low input/low output cropping systems in Malawi's rural areas use little or no fertilisers, hence the failure by farmers to maintain the equilibrium between nutrient supply and plant nutrient requirements. The Soils Fertility Commodity Team is responsible for soil fertility research and also the provision of accurate and timely soil and plant analytical services to all farmers. Development of technologies for replenishment of soil nutrients in the field is imperative if increased production is to be achieved.

**Goal**

To develop suitable soil, water, fertiliser and management technologies for increased productivity and sustainable agriculture.

15 **Constraints:** Soil Fertility

- (a) low organic matter and essential nutrients in soil;
- (b) inadequate land use information for crops and livestock production;
- (c) poor soil and water management practices;
- (d) insufficient organised database of soil and plant analytical data for easy and fast retrieval; and
- (e) untimely soil and plant analytical services to all researchers and farmers.

**Research Objectives**

- (a) investigate soil fertility factors which limit crop and livestock production;
- (b) investigate the effect of cultivation and land management practices on soil loss and surface run-off;
- (c) regularly review and standardise, the analytical methods and management procedures;
- (d) investigate the fate, movement and plant uptake of applied agro-chemicals in the soil;
- (e) determine the physical and chemical properties of the soil in relation to nutrient leaching, water holding characteristics, crop growth and yields;
- (f) provide accurate and timely soil and plant analytical services to all researchers and farmers; and
- (g) conduct collaborative research on problems related to soil fertility with other commodity teams.

**Expected Impact**

Improved soil fertility, reduced soil degradation and increased crop and livestock production.

**3.4.5.2 Soil Microbiology**

Malawi's soils are low in nitrogen. This is adversely affecting the yields of all crops including legumes. The use of appropriate legume species, rhizobia inoculants and inoculant application methods to seed legumes, will hasten nodulation for nitrogen fixation. The fixed nitrogen will in turn improve grain yields of such legumes.

**Goal**

To screen suitable rhizobia and develop appropriate inoculant methods of application for soil fertility and yield improvement of grain legumes.

**Constraints:**

- Soil microbiology*
- inadequate responsive legume varieties to indigenous rhizobia;
  - absence of suitable indigenous rhizobia;
  - suboptimal soil fertility;
  - inappropriate inoculant technology; and
  - low awareness of the value of inoculants in legume crops production.

**Research Objectives:**

- investigate biological nitrogen fixation (BNF) in different legume-based cropping systems and quantify BNF contribution to the nitrogen pool under such cropping systems such as inter-cropping and legume - cereal crop rotation;
- determine soil physico-chemical factors that limit nitrogen fixation by legumes;
- screen effective Rhizobium strains for use in making rhizobium inoculants as a cheap alternative to nitrogen fertilisers for legumes;
- develop appropriate inoculation technologies for easier adoption by both estate and smallholder farmers;
- increase public awareness on the use, importance and availability of rhizobia inoculants; and
- collaborate with other commodity teams and international organisations on all aspects of BNF.

**Expected Impact**

Legume varieties with desirable agronomic traits will be identified in association with efficient rhizobium strains. Increased awareness of inoculants and increased production of food legumes.

**3.4.5.3 Soil Survey**

The natural physical environment in Malawi exhibits remarkable spatial variation. Since the type of soil formed is a function of the physical environment, a corresponding spatial soil variation is expected. At the moment, the soil resources of Malawi are known only in general terms with regard to type, extent, location and potentialities. This greatly hampers rational planning of agricultural uses and rational transfer of agro-technologies from research stations to recipient areas. The Soil Survey team is responsible for characterising and identifying types of soils and their locations; estimating the area of land covered by each type of soil and other uses.

**Goal**

To provide soil classification and surveying services.

**Constraints**

- Soil Survey*
- lack of a detailed soil survey and comprehensive data for soil classification and morphology for the whole country;
  - lack of awareness of the available soil resources; and
  - lack of proper information for the land planner and the policy maker to aid them in sound land use plans and development policies.

**Research Objectives:**

- conduct soil survey and soil characterisation at research stations and trial sites;
- classify soils according to their physical and morphological characteristics; and
- classify soils using international and local classification systems.

**Expected Impact**

- the researcher, producer, land use planner and policy maker will be well informed about their soil resources;
- proper use of soil maps and soil reports to plan soil conservation measures within the ADDs.



#### 3.4.5.4 Farm Machinery

One of the major constraints faced by farmers in Malawi is labour shortage at peak periods. Since Malawi has a unimodal rainfall pattern, timeliness of operations and reduced drudgery is very important. Late or inadequate land preparation with accompanying late planting and weeding difficulties have usually resulted in low yields. Hand harvesting of crops and subsequent processing and transportation pose additional difficulties for farmers.

##### Goals

To reduce drudgery and increased timeliness of farm activities, through designing and evaluating of equipment and implements.

##### Constraints:

*Farm Machinery*

- (a) scarcity of appropriate farm machinery equipment causing low mechanisation in farming activities;
- (b) losses in product quality due to poor and inefficient facilities; and
- (c) untimely farm operations due to poor and inefficient equipment.

##### Research Objectives

- (a) develop small-scale implements in order to mechanise farm activities currently done by hand;
- (b) evaluate new machinery designed for farmers;
- (c) collaborate with other institutions dealing with farm machinery within and outside Malawi to enhance adaptation of technologies and strengthen linkages.

##### Expected Impact

Reduced drudgery and improved timeliness of farm operations. Reduced losses in production/ processing and increasing efficiency.

#### 3.4.5.5 Irrigation and Drainage

Frequent drought incidences and shortages of rainfall are severely limiting crops and livestock production. Irrigation is increasingly becoming a necessity for improving the agricultural industry especially in areas such as the Shire Valley where farmers are unable to grow important food and cash crops to improve their standard of living.

##### Goal

To develop irrigation-based technologies which will improve crop and livestock production, reduce risk of crop failure, convert idle land to productivity and enable multiple cropping.

##### Constraints:

- (a) inadequate knowledge on irrigation-based technologies;
- (b) insufficient irrigation facilities and technologies;
- (c) poor drainage of soil under irrigation; and
- (d) few trained staff in irrigation and drainage.

##### Research Objectives:

- (a) evaluate the consumptive use of water by the various crops throughout the year;
- (b) determine the irrigation regimes of various crops;
- (c) determine proper cultivation methods to be used in irrigation schemes;
- (d) select crop varieties suitable for irrigation;
- (e) intensify research in irrigation and drainage and
- (d) determine the optimum time of planting and appropriate systems of short and long term rotations.

##### Expected Impact:

Increased crop and livestock production through the availability of irrigation technologies.

#### 3.4.5.6 Agro-forestry

Agriculture in Malawi is faced with problems of declining soil fertility, high fertiliser costs, soil erosion and degradation of natural resources. Farmers are also faced with fuel and fodder shortage, lack of suitable multi-purpose tree species for mixed intercropping, contour buffer strips for erosion control, alley cropping, live fencing, boundary and homestead planting, green manure source and fodder banks.

**Goal**

To institutionalise an agro-forestry programme which will develop a systematic integration of crops, trees and livestock on the same land for increased resource and soil productivity.

**Constraints:**

- Agroforestry*
- inadequate appropriate agro-forestry technologies;
  - insufficient socio-economic evaluation of specific agro-forestry technologies;
  - the long time frame involved before realising significant benefits; and
  - rapid deforestation leading to land degradation.

**Research Objectives**

- develop agro-forestry interventions that address smallholder farmer's problems of declining soil fertility and low crop yields;
- enhance technology uptake for controlling soil erosion, surface run-off to improve rainfall infiltration and soil-water holding characteristics;
- develop technologies which reduce deforestation and arrest land degradation;
- develop and improve agro-forestry technologies that will provide sources of fuelwood, building material and supplemental fodder to livestock during periods of shortage;
- screening tree species and management practices for live fencing in different ecological regions of the country;
- increase awareness of agro-forestry systems interventions to the farming community; and
- quantify resource (water, nutrients and light) competition between trees and agricultural crops.

**Expected Impact**

Reduced soil degradation and use of inorganic fertilisers and increased yields.

**3.4.5.7 Mycotoxin and Aflatoxin Services**

The discovery of aflatoxin in agricultural commodities introduced a new area of research in mycotoxicology. The aflatoxins and mycotoxins occur in maize, groundnuts and most food products. Laboratory investigations have identified major factors influencing development of the toxin-producing species in storage, such as moisture, temperature, aeration and substrate. The infection of commodities by *Aspergillus flavus* and *Aspergillus parasiticus* subsequently lead to the production of aflatoxin. The aflatoxins and mycotoxins are believed to be associated with the incidence of carcinogenic diseases in both humans and animals.

**Goal**

To determine and quantify the contamination levels in stored produce by mycotoxins and aflatoxins.

**Constraints**

- loss of quality in stored cereals and oilseed products; and
- lack of trained personnel in aflatoxin detection.

**Research Objectives**

- conduct regular surveys of all food and cash crops and collect samples;
- test stored cereal and oilseed products for mycotoxin and aflatoxin infestations; and
- advise on proper control of such infestations.

**Expected Impact**

Food and cash crops free of aflatoxins.

**3.4.6 Plant Protection**

Plant protection safeguards the agricultural industry by preventing the introduction and spread of foreign pests and diseases not known to occur in Malawi; and recommends control of those pests and diseases present both in the field and in storage. This commodity group conducts research on the control of pests and diseases on all crops in Malawi. Most of the research programmes are commodity group-oriented whereby plant protection officers are assigned to work on various crops where researchable problems exist. Integrated pest management (IPM) is the main focus for pest and disease control.

Besides the research programmes, advisory services on the control of pests and diseases are provided by this commodity group to the farming community. These services are provided free of charge. More than 50% of the activities of the plant protection commodity group are non-researchable but protect the agricultural industry from pests and diseases to ensure increased food security.

### 3.4.6.1 Plant Quarantine and Produce Inspection

An effective quarantine system for incoming and outgoing plant material and products is vital to protect local agriculture from the importation of pests and diseases, and to facilitate export of fruit, vegetables, plant products in accordance with the quarantine standards of the importing countries. Stringent measures against entry of foreign pests and diseases not known to occur in Malawi are taken to protect Malawi's agricultural industry. Strict checks are done in all the border posts and at the international airports on any imported seeds and plant material. Equally important is the enforcement of measures to protect the export market to ensure Malawi's agricultural exports are free from insect pests and diseases.

#### Goal

- (a) to prevent the introduction and spread of diseases and pests;
- (b) to protect and improve quality of stored agricultural produce.

#### Constraints

- (a) limited quarantine facilities where plants can be grown under observation after importation.
- (b) shortage of skilled personnel at professional level.
- (c) lack of border post facilities for on-site inspection.
- (d) inadequate storage hygiene awareness information.
- (e) inadequate inspection services in all warehouses where commodities are stored.
- (f) out-dated legal framework for quarantine.

#### Services Objectives

- (a) inspect imported agricultural produce for pests and diseases.
- (b) develop appropriate control measures for major diseases and pests.
- (c) advise the general public on the dangers posed by exotic pests and diseases.
- (d) implement appropriate plant protection regulations aimed at strengthening plant quarantine structures.
- (e) protect and maintain good phytosanitary conditions of stored agricultural produce.
- (f) certify that agricultural products exported and imported are free from diseases and pests.

#### Expected Impact

- (a) increased availability of pest and disease-free agricultural produce on the world market from Malawi.
- (b) improved quality of agriculture produce within Malawi; and
- (c) control of pest and disease epidemics in the country.

### 3.4.6.2 Plant Pathology

Crop yields are adversely affected by plant diseases and weeds. It is important that these diseases and weeds are controlled if high and sustainable yields are to be realised. The screening of many disease control options is conducted in Plant Pathology including the integrated approach on or disease management. Advisory services are also provided to the farming community on the identification and control of plant diseases.

#### Goal

To develop technologies for controlling diseases and weeds.

#### Constraints

- (a) high incidence of diseases and weeds.
- (b) lack of resistant varieties.
- (c) high cost of pesticides.
- (d) inadequate number of appropriate control measures of diseases and weeds of a number of crops.
- (e) inadequate number of trained manpower and laboratory facilities for weed science.
- (f) inadequate biocontrol strategies.

#### Research and Service Objectives

- (a) develop appropriate disease and weed control and management strategies for various agricultural (and horticultural) crops.
- (b) develop IPM strategies to control diseases and weeds.
- (c) provide advisory services on disease and weed identification and control measures.
- (d) establish a weed science laboratory.

**Expected impact**

- (a) increased crop yields of high quality; and
- (b) IPM strategies on disease control used by farmers.

**3.4.6.3 Nematology**

Plant-parasitic nematodes cause considerable damage to many crop plants. Some crops of economic importance such as tobacco cannot successfully be grown without controlling nematodes. The yields of some of the crops such as tomatoes, bananas, cotton, potato and pigeonpeas are also adversely affected by nematodes. Because of their insidious nature, the damage caused by these pests are often confused with other soil conditions. The losses caused by nematodes to some highly susceptible crops could be up to 100 %.

**Goal**

To control plant-parasitic nematodes to achieve high crop yields.

**Constraints**

- (a) inadequate knowledge on the incidence of root-knot nematodes;
- (b) inadequate control measures for some of nematodes prevalent in Malawi;
- (c) inadequate knowledge on the incidence and distribution of nematodes; and
- (d) high cost of nematicides.

**Research and Services Objectives**

- (a) determine incidence and distribution of nematodes in Malawi;
- (b) identify crop varieties resistant to nematodes;
- (c) develop appropriate control measures for some of the parasitic nematodes on various crops; and
- (d) create awareness on the effects of nematodes on crop production.

**Expected Impact**

- (a) increase crop yields due to nematode control; and
- (b) increased awareness on nematode damage to crops.

**3.4.6.4 Entomology**

Most of the pest problems farmers face are entomological and are a major constraint to crop production. While most of the field pests attacking crops in Malawi are non-migratory, a few are migratory and difficult to control. Some of these insect pests such as migratory locusts do not respect international boundaries and should also be controlled.

**Goal**

To develop appropriate insect pest management systems.

**Constraints**

- (a) lack of baseline data on pest status in the country;
- (b) Inadequate number of appropriate control measures for pests of economic importance;
- (c) inadequate number of specialised facilities and trained manpower;
- (d) inadequate number of resistant crop varieties;
- (e) high cost of insecticides and pest control equipment; and
- (f) lack of insect reference collection and local publications.

**Research and Services Objectives**

- (a) develop appropriate control measures for pests;
- (b) strengthen monitoring, forecasting, and control services on migrant pests;
- (c) establish baseline data for pests of economic importance;
- (d) develop a comprehensive insect reference collection;
- (e) collaborate with plant breeders in the identification and screening for varietal resistance;
- (f) produce a manual on identification and control of migrant pests, and a handbook on identification and control of field pests; and
- (g) develop IPM strategies for the control of insect pests.

### Expected Impact

- (a) increased crop yields due to insect pest control;
- (b) improved forecasting systems for migratory pests in place; and
- (c) reduced use of pesticides.

#### 3.4.6.5 Crop Storage

Many storage pests attack crops in the field and continue to multiply in storage. This reduces both the potential storable quantities and the quality of the produce. There is need, therefore, to develop appropriate control measures to reduce these losses.

#### Goal

To reduce post-harvest crop losses in quantity and quality.

#### Constraints

- (a) high post-harvest crop losses;
- (b) inappropriate storage facilities;
- (c) inadequate, unaffordable and effective protective measures for on farm storage; and
- (d) low of awareness on existing protective measures which can effectively and safely control insect pests during storage.

#### Research and Service Objectives

- (a) develop technologies to reduce post-harvest losses;
- (b) screen synthetic insecticides and materials from indigenous plants for use as grain protectants;
- (c) develop and test modified structures for storage of seed potatoes; and
- (d) advise farmers, and train extension workers on the appropriate crop storage techniques.

#### Expected Impact

- (a) increased use of appropriate storage technologies;
- (b) IPM strategies in use by farmers; and
- (c) reduced losses of stored produce.

#### 3.4.6.6 Regulation of Pesticides

Pesticides have been used for the control of insect pests and diseases of crops. In Malawi there is no legislation on the use, importation and sale of these pesticides. This has led to indiscriminate use of pesticides which are a hazard to both humans and the environment.

#### Goal

To control the indiscriminate use of pesticides.

#### Constraints

- (a) lack of pesticide registration scheme;
- (b) non implementation of pesticide legislation;
- (c) widespread use of prohibited (banned) pesticides in the country; and
- (d) uncontrolled importation, sale, and use of pesticides.

#### Research and Services Objectives

- (a) develop a pesticide registration scheme and legislate pesticides;
- (b) test all new pesticides for safety and effectiveness;
- (c) enforce non-usage of pesticides banned in other countries; and
- (d) recommend to farmers pesticides for control of diseases and pests.

#### Expected Impact

Controlled importation, sale and use of pesticides.

#### 3.4.7 Agricultural Technical Services

The Agricultural Technical Services Commodity Group consists of Seed Services; (AGREDAT); Library and Information Services; and Plant Genetic Resources Centre (Gene Bank) commodity teams. The group conducts research and provides advisory services in seed inspection and certification; design and analyses of experiments; economic evaluation of production technologies; maintenance of plant genetic material; and proper documentation of the information systems of other commodity groups and the farming community.

### 3.4.7.1 Seed Services

The availability of high quality seeds is fundamental to increased agricultural production. One of the causes of low yields in the country is the use of seeds of poor quality. The Seed Services commodity team aims at ensuring that farmers use good quality seeds.

#### Goal

To ensure that farmers use high quality seeds.

#### Constraints

- Technical Services*
- (a) under-developed seed certification procedures for some agricultural (and horticultural) crops;
  - (b) inadequate inspections and certification; and
  - (c) poor enforcement of the seed Act.

#### Research and Services Objectives

- (a) develop appropriate technologies and standards for certified seed production;
- (b) ensure that seed crops are grown in accordance with internationally-recognised certification standards;
- (c) monitor the quality of seed, either locally produced or imported, sold to farmers;
- (e) participate in the development and promotion of on-farm seed saving and testing technologies;
- (f) participate in the development of strategic seed reserves;
- (g) collaborate with plant breeders in the provision of start up material (basic seed) to the seed industry; and
- (i) co-ordinate the role of NGOs in seed multiplication, production, distribution and storage.

#### Expected Impact

Adequate quantities of good quality seeds will be available to farmers.

### 3.4.7.2 Agricultural Economics, Statistics and Data Processing (AGREDAT)

Appropriate technologies are easily produced if, among other things, proper experimentation procedures are followed in the first place. Farmers readily adopt technologies which are socio-economically acceptable to them. The AGREDAT commodity team ensures that scientists follow the right experimentation procedures in executing their experiments and that all technologies developed by scientists are subjected to socio-economic evaluation before passing them on to farmers.

#### Goal

To ensure that proper statistical designs and socio-economic analyses for research programmes are used.

#### Constraints

- AGREDAT*
- (a) inadequate knowledge about the statistical designs and socio-economic analysis of experiments;
  - (b) inadequate statisticians and socio-economists;
  - (c) inadequate analytical tools and facilities; and
  - (d) inadequate knowledge about analytical packages.

#### Research and Services Objectives

- (a) provide statistical advice to scientists on planning and implementation of experiments, analysis and interpretation.
- (b) conduct economic evaluation of technologies being developed;
- (c) conduct in-service training in data analysis and interpretation;
- (d) provide analytical tools and facilities; and
- (e) create DAR DATA BANK.

#### Expected Impact

Increased use of correct experimental designs; better data analysis and interpretation of research programmes and socio-economic analysis.

### 3.4.7.3 Library and Information Services

The Library and Information Services commodity team is dynamic with a constant supply of information on scientific, agricultural, socio-economic, nutritional, agrometeorological and educational issues, among others. Proper documentation of literature is one of the important aspects of the documentation services.

**Goal**

To upgrade and improve information flow and support system to enhance research and technology development.

**Constraints** *Library*

- 28
- (a) inadequate access to information due to a large number of uncatalogued documents, especially "grey literature";
  - (b) lack of computers at branches to access computerised catalogues;
  - (c) lack of networking of data bases within the Ministry of Agriculture and Livestock Development;
  - (d) inadequate funding, trained manpower and library space; and
  - (e) poor telecommunications among branch libraries.

**Services Objectives**

- (a) make available a collection of materials that provide information for research programmes;
- (b) create a computerised network system for DAR's data bases;
- (c) train manpower for documentation systems; and
- (d) acquire, and subscribe to, materials including books, periodicals, slides, video tapes and files for DAR.

**Expected Impact**

- (a) increased access to information; and
- (b) increased supply of appropriate literature to various institutions and the general public.

**3.4.7.4 Plant Genetic Resource Centre (Gene Bank)**

The country's plant genetic resources are threatened of extinction. There is need, therefore, to preserve them to maintain genetic diversity.

**Goal**

To collect, characterise document and maintain the plant genetic diversity.

**Constraints** *Genetic Res*

- 29
- (a) indiscriminate destruction of plant genetic resources;
  - (b) inadequate documentation of germplasm available in Malawi; and
  - (c) inadequate seed processing and storage facilities.

**Research and Service Objectives**

- (a) collect, characterise, document and conserve the plant genetic resources available in Malawi;
- (b) devise appropriate methods of germplasm conservation;
- (c) provide information on characterised plant genetic resources; and
- (d) create awareness about and map out conservation strategies.

**Expected Impact**

Continued availability of indigeneous and adapted species for the present and future exploitation in breeding of new superior varieties.

## CHAPTER 4

### AGRICULTURAL RESEARCH PRIORITY SETTING

#### 4.1 JUSTIFICATION

There is ample evidence that the establishment of a strong, dynamic and productive agricultural system plays a major role in the social and economic development of a country. Currently, the department is allocating resources based on historical setting. This is detrimental to the focusing on problem-oriented resource allocation. The weakness of using traditionally based allocation mechanism is that it allows traditionally larger commodity groups obtaining more resources even after their roles have been toned down. Most research programmes are curtailed by difficulties in funding. In developing countries, most research and technology development programmes are recipients of public funding.

In order to allocate both financial, physical and human resources efficiently, it is necessary for the DAR to devise scientific and systematic methods which can help in resource allocation. This chapter, therefore, presents "through-the-art-methods" used in obtaining priority guidelines. These guidelines can be used in determining resource allocations and switch-overs, where necessary. Based on set goals and available resources, it is hoped that resources can be allocated using the findings of the priority setting analysis.

With the aforementioned in mind, the department seeks to utilise the priority setting methods to enhance efficiency in resource allocation. Furthermore, this chapter also presents the different levels of importance of different crops and livestock both at national and ADD levels. The services performed have also been ranked. To solve this problem, any funds made available for research should be allocated to programmes according to national priorities and policy makers should be convinced of the need to invest more in research.

#### 4.2 GUIDELINES FOR PRIORITY SETTING

There are several techniques for setting research priorities. Each technique is suitable for a particular purpose or country with minor adjustments to the criteria used. Information on past research and knowledge of the farming systems in different parts of the country is required for a proper evaluation of such priorities. Subjective elements should be minimised in setting priorities of research and service programmes. The use of highly knowledgeable and experienced researchers and extension staff should be considered. A simple method for setting research priorities at national and ADD levels was developed in order to make the best decisions on resource allocation between and within commodity research programmes. This system includes a detailed analysis of commodity research priorities according to national aims, policies, ADD requirements, and also by considering social, physical, economic, research and technical factors. Research priorities were also derived from information and experiences of NRCs, CTLs and extension specialists. This would entail development of standard methods that allow comparison between commodity programmes.

The above system represents only a standard tool of analysis for setting priorities. Although the process may seem arbitrary, it is objective enough and should be considered to be as a relative comparison between and within commodities. As such, it can only be used to facilitate the decision making process. The outcome of such an analytical process should not be viewed as being rigid. As the importance of particular factors change or new factors emerge, commodities must be moved within the priority ranking.

The commodity priorities were determined after considering all the major and potential crops and livestock. Commodities such as tea, tobacco and sugarcane, for which DAR has no research mandate, were omitted in the final list of research priorities.

##### 4.2.1 National Research Priorities

The national priorities of research were based on guidelines set out in the Statement of Development Policies 1987-1996. Research commodities were evaluated in relation to their contribution to national food self-sufficiency, export value, potential as cash crop and for import substitution, lack of available (on-shelf) technologies, differences in yields obtained by farmers compared to yields obtained by researchers (yield differential), and demand for new technology by producers.

##### 4.2.2 ADD Research Priorities

Commodities were prioritised according to the ADDs using the guidelines for setting national research priorities. This was found necessary because ADDs represent the administrative divisions of the country's agricultural development programme. Thus, implementation of research activities would be made easier at ADD level. Consideration was also given to the importance and potential of the commodities in each ADD. Those commodities considered as unimportant were left out of the priority setting exercise for specific ADDs.

#### 4.3 CRITERIA FOR PRIORITY SETTING

##### 4.3.1 National Goals and Objectives

Current national goals aim at maintaining food self-sufficiency, increasing exports of agricultural products, promoting the production of cash crops and encouraging production of commodities to



substitute imported ones. If a commodity has very high potential for fulfilling food self-sufficiency, it has been given a rating of 100%; that with high potential is 80%, medium is 60%, low is 40%, very low is 20% and if non-significant is 0%. The same ratings have been used for the commodity's potential as an export, cash or an import substituting product.

All the commodities were rated according to the four factors from very high (100%), high (80%), medium (60%), low (40%), very low (20%) to non-significant (0%); each of the four factors was assigned a weight in relation to its importance to the national economy. Food value of a commodity was weighted as 1.0, export value as 0.8, cash value as 0.6 and import substitution as 0.4. A commodity's rating from 0 to 100% for a particular factor was multiplied by the weight in order to arrive at a score within each of the factors as shown in Appendix II.

Maize has a very high food value and was rated 100%. However, it has low export value, cash value and import substitution value hence was rated 20, 40 and 40 respectively. Cattle also have a high food value and cash value so they were rated 80% for each of the two factors. Coffee, spices, tree nuts and tobacco have a high export value and hence were each rated 80%. Cotton and tobacco have very high cash value and were rated 100%.

The sub-total for each commodity was obtained by adding scores for food value, export potential, cash value and import substitution effects and the average score was calculated by dividing the sub-total by four. Appendix II, therefore, shows that maize and rice are the most important commodities for food as shown by the average scores (39) which are the highest among the commodities.

The two cereals were followed by beans, cattle and vegetables which scored highly on the cash value. In general, beans, cattle, maize, poultry, rice and vegetables scored the highest on food value. Coffee, spices, sugar cane, tea, tobacco and tree nuts scored the highest on export value. Beans, cattle, cotton, spices, and tobacco scored highest on cash value. Lastly, cattle, coffee, cotton, mushroom, deciduous fruits and wheat scored the highest on import substitution. All commodities were evaluated for their national importance in this manner.

The commodities were divided into four main priority groups to determine the national production priorities. Priority I represents the highest priority while Priority IV represents the lowest priority. The commodities which scored above 30 were placed in Priority I, those between 25 and 29 in priority 2, between 20 and 24 in Priority III and those below 20 in Priority IV as shown in Table 4.1. as drawn from Appendix 2.

Table 4.1: Commodity Priorities According to National goals

| PRIORITY I      | PRIORITY II | PRIORITY III     | PRIORITY IV |
|-----------------|-------------|------------------|-------------|
| Maize           | Pigeonpeas  | Sweet potato     | Chickpeas   |
| Rice            | Potato      | Deciduous fruits | Sorghum     |
| Groundnuts      | Pigs        | Cowpeas          | Millet      |
| Cattle          | Cassava     | Goats            | Rabbits     |
| Vegetables      | Mushroom    | Pastures         |             |
| Beans           | Soyabeans   | Wheat            |             |
| Coffee          | Guarbeans   |                  |             |
| Citrus          | Sheep       |                  |             |
| Spices          | Sunflower   |                  |             |
| Poultry         |             |                  |             |
| Tropical fruits |             |                  |             |
| Cotton          |             |                  |             |
| Tree nuts       |             |                  |             |

#### 4.3.2 Research and Technical Factors

An evaluation was made on the need for research and technology to be developed for each of the commodities. This was after prioritising commodities according to national importance. The values assigned for these factors were in relation to the importance which was attached to a particular commodity within the national economy. Three main factors were used to assess research and technical needs of a research commodity. These are listed below in order of importance.

(a) **Lack of available (or on-shelf) technology:**

This is a factor which gives an indication of whether or not new or desired technologies for a particular commodity are available from research. If a large amount of information is available, there is lack of on-shelf technology and the commodity has less need for research and is rated 0%. When there is no information available, there is great (or very high) need for research and the rating is 100%. Between these two extremes are ratings of high (80%), medium (60%), or low (40%) and very low (20%) ratings. This factor has a weight of 1.0, which is used to multiply with the ratings to obtain the score for lack of on-shelf technology.

(b) **Yield differential:**

This represents the gap between the average national yields and the potential yields obtained in research trials of a commodity. The ratings given are an inverse proportion to this gap. If a crop has an average yield of 20% of those from research, an 80% yield gap is assigned to the commodity. This shows that a farmer has not been influenced a great deal by innovations from research to increase production. These ratings range from 100% (very big gap), medium (60%) low (40%) or very low (20%) and non-significant (0%). These ratings are again multiplied by a weighting factor of 0.8 to obtain the score.

(c) **Demand for technology:**

With a weighting of 0.6, this factor evaluates the need for technology by farmers. Often this information will be obtained from extension workers or farmers who may demand technologies directly from a research institution. If the demand is very high, the rating is 100%; and thereafter it may vary from high (80%) to low (40%) or very low (20%). These ratings are again multiplied by the weight factor to obtain the score. After deriving the scores for each of the three research and technical factors, the sub-total is divided by three to obtain a mean score for these factors.

The scores in Appendix III show that maize has high on-shelf technology which is not being utilised by farmers while cowpeas, cotton, goats, citrus and tree nuts have little on-shelf technology available. In general, coffee, cotton, cowpeas, goats, sunflower, tree nuts, tropical fruits and citrus have little on-shelf technology while cattle, cotton, groundnuts, potato, millets, pigeon peas, poultry, rice, sorghum have the potential to increase yield achieved by farmers. A lot of technology is demanded for cotton, coffee, mushroom, poultry, tree nuts and tropical fruits.

A final review of all the commodities suggests that where more funds have been spent (e.g. maize) for research in the past, there is an ample amount of available (or on-shelf) technology than where less funds have been used (e.g. millets). The demand for technology by farmers is greatly affected by its appropriateness to their needs. Yield differential is affected by the demand for technology and how much of the technology demanded is used for increasing production. Other factors such as availability of inputs also influence the differences between farmers' and researchers' yields.

To determine the priorities according to research needs, the commodities were divided into 4 main priority groups. Priority Group I has the highest priority for research and Group IV has the least priority for research. Commodities which scored above 50 were placed in priority 1, those between 45 and 49 in Group II, between 40 and 44 in group 3 and those below 40 were placed in priority Priority IV as shown in Table 4.2. and derived from appendix 3.

Table 4.2: Commodity Priorities According to Research Needs and Technical Factors

| PRIORITY I       | PRIORITY II | PRIORITY III | PRIORITY IV |
|------------------|-------------|--------------|-------------|
| Tropical fruits  | Wheat       | Beans        | Maize       |
| Cotton           | Sorghum     | Sheep        | Pastures    |
| Coffee           | Vegetables  | Spices       | Rabbits     |
| Tree nuts        | Cassava     | Sweet potato | Guar Beans  |
| Citrus           | Groundnuts  | Chickpeas    | Millet      |
| Poultry          | Rice        | Pigs         |             |
| Sunflower        | Soya beans  |              |             |
| Cattle           | Goats       |              |             |
| Deciduous fruits |             |              |             |
| Pigeon peas      |             |              |             |
| Mushroom         |             |              |             |
| Cowpeas          |             |              |             |
| Potato           |             |              |             |

Any constraints identified within each of the commodities in Priority I should receive proportionally the highest level of importance when allocating resources to research programmes. On the other hand, commodities in Priority IV should receive the lowest level of importance. The crops within each priority commodity group are listed according to their order of importance.

4.4 **DETERMINATION OF COMMODITY RESEARCH PRIORITIES AT NATIONAL LEVEL**

To arrive at national research priorities, the average scores for national factors were added to average scores for research and technical factors. Appendix IV shows the final scores of research priorities for all commodities. The final score is simply the sum of the two previous scores. The scores for the national factors ranged from 8 to 41 and those for research and technical factors from 24 to 64. After adding the two, the final scores range was 37 to 96. This information was used to establish the actual ranks (from 1 to 32) of each commodity by factor (Appendix V).

To determine the national research priorities, it was decided to divide the commodities into four main priority groups; with Group I being commodities with the highest priority for research, and Group IV being the lowest priority. Commodities which had scored above 80 were placed in Priority 1, those between 70 and 79 in Priority II, 60 to 69 in Priority III and below 60 in Priority IV (Table 4.3).

Table 4.3: Final score of National Commodity Research Priorities

| PRIORITY I      | PRIORITY II      | PRIORITY III | PRIORITY IV |
|-----------------|------------------|--------------|-------------|
| Tropical fruits | Soya beans       | Pigs         | Pastures    |
| Coffee          | Beans            | Sweet potato | Rabbits     |
| Citrus          | Spices           | Sheep        | Chickpeas   |
| Cattle          | Mushroom         | Sorghum      | Guar beans  |
| Cotton          | Deciduous Fruits | Goats        | Millet      |
| Poultry         | Sunflower        |              |             |
| Tree nuts       | Cowpeas          |              |             |
| Rice            | Wheat            |              |             |
| Vegetables      | Maize            |              |             |
| Groundnuts      | Cassava          |              |             |
| Pigeon peas     |                  |              |             |
| Potato          |                  |              |             |

The prioritisation of commodities at DAR level is shown in Table 4.3. This method of prioritisation has placed tropical fruits, coffee, citrus, cattle and cotton on top of the commodities in DAR. Furthermore, maize and cassava are in priority group II and are ranked 20 and 10, respectively, among all the commodities. The use of national goals and research and technical factors has resulted in relegating or promoting some commodities to various ranks. For example, maize is in Priority I on the national goals (Table 4.1) but falls to Priority IV when research and technical factors were considered (Table 4.2). The final score at national level (Table 4.3) places maize in Priority II while treenuts or cotton fall in Priority I.

#### 4.5 RESEARCH PRIORITY SETTING BETWEEN AND WITHIN COMMODITY GROUPS

The financial, human and physical resources available to a commodity research team in DAR are usually limited. It is important, therefore, that National Research Co-ordinators, together with Commodity Team Leaders, should employ formal and rational methodologies in priority setting to optimise the use of scarce resources. The formal methods of priority setting have the added advantage of being defensible as opposed to the use of intuition and experience.

Out of the several formal methods for priority setting that have been developed by the International Service for National Agricultural Research (ISNAR), as detailed in Norton and Pardey (1987), the scoring method and checklist method are apparently the most useful and appropriate for priority setting between and within commodity research teams in DAR and also at the ADD level. The scoring and checklist methods were chosen for this exercise over the more sophisticated methods. These two methods are the most conceptually defensible procedures, most transparent and are readily understood by non-specialists.

##### 4.5.1 Scoring Method

The scoring method involves identification of objectives for the research systems, obtaining weights for those objectives, choosing a set of criteria by which to measure the contribution of each commodity to the objectives, collecting data on the criteria and then applying weights to arrive at a ranking by commodity or commodity group or research area. This method incorporates a substantial quantity of subjective information. These subjective judgements are relatively transparent and this facilitates understanding and testing of the judgements. The approach provides an initial ranking of priorities which can easily be examined in the light of factors difficult to quantify.

##### 4.5.2 Checklist Method

This methodology entails the use of initiative, experience and common sense in determining the priorities. Checklists are conceptually simple and make a strong appeal to common sense. Even when planning involves one of the more formal techniques, it is useful to go through a checklist in order to ensure that all major issues are encapsulated in the elements of the more formal method deployed. Detailed below is a checklist which was used for priority setting within and between commodity groups in DAR as an additional method to the scoring methodology.

#### CHECKLIST 1

1. What are the major problems facing farmers involved in a particular commodity in a region?
2. What type of research is required to overcome those problems?
3. Can the research information needed be obtained/adapted from other sources (e.g. IITA)?
4. Is there any new technology ready for transmission to farmers?
5. How high are chances of success for particular research areas?
6. What is the expected increase in yield or improvement in quality from particular types of research?
7. What is the expected time frame within which research results may be obtained?
8. What will be the acceptability of particular types of technologies?
9. Is more importance attached to helping small than large/estate farmers?
10. Is the commodity currently being exported or imported?
11. What will be the impact of research technology on imports or exports of the commodity?
12. What proportion of each commodity is consumed in the household?
13. Is the production or marketing of the commodity organised or supported in any way?
14. What are the most limiting production factors (inputs) in the region?
15. Can this research be conducted by the private sector or through contract research?

Further questions involve providing answers to technical feasibility, research cost, research direction, programme comprehensiveness, emphasis of research, relevance of research and "researchability" of the projects.

## CHECK LIST II

1. Is scientific manpower available?
2. Is there any technical support?
3. Are facilities and equipment available?
4. How much will the research cost be to completion?
5. To what degree is the research important and in line with policy objectives?
6. Does the project contribute to a comprehensive research programme?
7. What are the chances of success?
8. What is the possible degree of adoption?
9. What is the effect on the economy of farmers?
10. Will the research contribute to national goals?
11. What is the likely impact of the research?
12. Are there other ways of obtaining desired results?

There are instances when common sense dictates that a research project is of very low priority. It is futile and a waste of time and money to resort to a formal method just to prove that such a project is of low priority. Research projects that affect productivity can easily be treated by formal methods of priority setting, whereas others, such as soil classification and soil conservation, cannot easily be subjected to the formal methods.

Using these two methods, it was easier to prioritise all commodity teams including services. The seven senior scientists (NRCs) simply run through the questions contained in the checklist and then drew a priority list based on the answers obtained. No further analysis was required.

### 4.5.3 Research Services Group

The research services commodity teams in DAR play a vital role in servicing the research commodity groups and the agricultural community as a whole. By the nature of their service activities, it is difficult to prioritise which services groups are more important, at national level, than others. However, an attempt was made to prioritise disciplines within the services groups. DAR headquarters staff who allocate resources to commodities should be cognizant of the important role these disciplines and services groups play and should allocate adequate resources to them to ensure that they operate efficiently.

## 4.6 ALLOCATION OF FUNDS IN RELATION TO PRIORITIES

An important reason for priority setting is to enhance the optimisation of the use of scarce resources. Sound decision on the allocation of funds to competing research commodities can only be made when DAR headquarters staff are cognizant of the importance of the commodities in the national economy. Although funds will be allocated according to the priorities established in this document, efforts must be made to ensure that there is activity in each of the priority groups. In addition to the formal method of allocating funds, it is recommended that DAR headquarters staff should take the following criteria into consideration:

- (a) consider the research/technical constraints within each commodity;
- (b) consider the appropriateness of the proposed research budget in relation to the research work needed to solve the constraints; and
- (c) some commodities are inherently more expensive to research on, and due consideration should be given to this aspect.

### 4.6.1 Prioritisation of Commodity Groups relative to Resource Allocation

The DAR is organised into seven commodity groups namely: Cereals, Horticulture, Livestock and Pastures, Legumes Fibres and Oilseeds, Soils and Agricultural Engineering, Agricultural Technical Services and Plant Protection Services. An attempt was made to prioritise these commodity groups according to their potential to fulfil the national goals and research needs. The scientists assessed the groups by the answers obtained to the questions contained in the checklist. The groups were ranked from one to seven since there are seven of them. The group that had the highest potential to fulfil the national goals and research needs was assigned rank one and the one with the lowest potential was assigned rank seven. Thereafter, all the rank numbers for each commodity group were added and divided by seven because they were seven scientists who assigned ranks. An average rank was obtained for each group. The group with the least rank number was rated one while that with the largest mean rank number was assigned seven as shown in Table 4.4 with further details in Appendix V1.

After ranking the commodity groups, each rank was assigned a weight. Ranks one, two, three, four, five, six and seven were weighted 100%, 90, 80, 70, 60, 50 and 40% respectively. Then all the weights were added together to make 490. To calculate the percentage of funds to be allocated to each commodity by DAR, each weight was divided by

the denominator (490) and then multiplied by 100. The percentage of funds to be allocated to each commodity by DAR according to priorities are shown in the last column of Table 4.4.

Table 4.4: Ranking of Commodity Research Groups According to National Goals, Research Needs and Resource Allocation

| Commodity Group             | National Goals (Rank) | Weight (%) | Resource Allocation (%) |
|-----------------------------|-----------------------|------------|-------------------------|
| Cereals                     | 1                     | 100        | 20.4                    |
| Horticulture                | 2                     | 90         | 18.4                    |
| Livestock and Pastures      | 3                     | 80         | 16.4                    |
| Legumes, Fibre and Oilseeds | 4                     | 70         | 14.3                    |
| Soils and Agric. Eng.       | 5                     | 60         | 12.1                    |
| Technical Services *        | 6                     | 50         | 10.2                    |
| Adaptive Research**         | 7                     | 40         | 8.2                     |
| Total                       | 490                   | 100.00     |                         |

\* Groups together Agricultural Technical and Plant Protection Services groups.

\*\* Dissolved on 31-12-94.

The information in Table 4.4 shows that of all DAR research budget, especially operational funds, Cereals should get financial resources amounting to 20.4% followed by Horticulture (18.4%), Livestock and Pastures (16.4%), Legumes and Oilseeds (14.3%), Soils and Agricultural Engineering (12.1%), Technical Services (10.2%) and Adaptive Research (8.2%).

#### 4.6.2 Prioritisation Within Commodity Groups Relative to Resource Allocation

After prioritising the commodity groups, an attempt was made to prioritise the commodities within the commodity groups. This prioritisation was based both on national factors and research factors as detailed in the preceding section (section 4.8). An effort was also made to prioritise the agricultural services commodity teams (Table 4.5).

Table 4.5: Prioritisation of research commodity teams relative to national importance, research and technical factors and resource allocation.

| CROP/COMMODITY                            | IMPORTANCE (RANK) | WEIGHT (%) | RESOURCE ALLOCATION (%) |
|---|-------------------|------------|-------------------------|
| <b>CEREALS</b>                            |                   |            |                         |
| Maize                                     | 1                 | 100        | 29.4                    |
| Sorghum/Millet                            | 2                 | 90         | 26.5                    |
| Rice                                      | 3                 | 80         | 23.5                    |
| Wheat/Barley                              | 4                 | 70         | 20.6                    |
| <b>HORTICULTURE</b>                       |                   |            |                         |
| Vegetables                                | 1                 | 100        | 22.2                    |
| Root & Tubers                             | 2                 | 90         | 20.0                    |
| Tropical Fruits                           | 3                 | 80         | 17.8                    |
| Tree nuts                                 | 4                 | 70         | 15.6                    |
| Coffee                                    | 5                 | 60         | 13.3                    |
| Deciduous Fruits                          | 6                 | 50         | 11.1                    |
| <b>LIVESTOCK AND PASTURES</b>             |                   |            |                         |
| Large Ruminants                           | 1                 | 100        | 29.4                    |
| Monogastric                               | 2                 | 90         | 26.5                    |
| Small Ruminants                           | 3                 | 80         | 23.5                    |
| Pastures                                  | 4                 | 70         | 20.6                    |
| <b>LEGUMES, FIBRES AND OILSEEDS</b>       |                   |            |                         |
| Cotton                                    | 1                 | 100        | 25.0                    |
| OGL                                       | 2                 | 90         | 22.5                    |
| Groundnuts                                | 3                 | 80         | 20.0                    |
| Beans                                     | 4                 | 70         | 17.5                    |
| Oil Seeds                                 | 5                 | 60         | 15.0                    |
| <b>SOILS AND AGRICULTURAL ENGINEERING</b> |                   |            |                         |
| Soil Fertility                            | 1                 | 100        | 22.5                    |
| Agroforestry                              | 2                 | 90         | 20.0                    |
| Irrigation and Drainage                   | 3                 | 80         | 17.8                    |
| Agric. Engineering                        | 4                 | 70         | 15.6                    |
| Soil Survey                               | 5                 | 60         | 13.3                    |
| Soil Microbiology                         | 6                 | 50         | 11.1                    |
| <b>TECHNICAL SERVICES</b>                 |                   |            |                         |
| Seed Services                             | 2                 | 90         | 17.3                    |
| Library                                   | 4                 | 70         | 13.5                    |
| Gene Bank                                 | 5                 | 60         | 11.5                    |
| AGREDAT                                   | 6                 | 50         | 9.6                     |
| <b>PLANT PROTECTION SERVICES</b>          |                   |            |                         |
| Plant Pathology                           | 1                 | 100        | 19.2                    |
| Quarantine/Inspection                     | 3                 | 80         | 15.4                    |
| Crop Storage                              | 7                 | 40         | 7                       |
| Pesticide Regulations                     | 8                 | 30         | 5.8                     |

Note: Nematology and Entomology were grouped together as Plant Pathology.

Funds allocated to a commodity group e.g. cereals (20.4%) should be divided among the other commodities within the cereals group i.e. maize, sorghum/millet, rice and wheat/burley. The percentage of allocation to each commodity to be used is shown in the last column of Table 4.5. This applies to the rest of the commodity groups.

#### 4.7 DETERMINATION OF COMMODITY RESEARCH PRIORITIES AT ADD

Commodity priorities at ADD level were made by the most senior members of staff of each ADD. To do so, the following approach was used. Firstly, a list of crops and livestock was made and each ADD grouped them into four categories i.e. very important, important, less important and least important (Appendix VII). To determine these categories, each commodity was assessed against the following factors:

- area under production;
- number of farmers involved or affected;
- number of animals or amount of milk or eggs produced;
- production levels;
- economic value;
- import substitution;
- food security;
- crop or livestock diversification; and
- experience of ADD personnel.

Secondly, the commodities in each ADD were prioritised (Appendix VIII) according to research needs while considering the following factors:

- lack of on-shelf technology;
- yield differential;
- demand for technology; and
- personal experiences of ADD personnel.

After the ADDs had separately prioritised the commodities according to the importance and research needs, the two factors were considered together to determine the ADD priorities. This was done as follows: The factors of importance and research needs were weighted against the 4 priorities as shown in Table 4.6. The weights in this Table mean that a crop/livestock appearing in priority group 1 an importance score was assigned a weight of 1 and if the same crop/livestock appears in priority III of research needs it was assigned 0.4. The two scores (1 and 0.4) were, for example, added to make the total score of 1.4 for each commodity at ADD level (Table 4.7).

The total scores in this Table were used to generate the priority groups at ADD level (Table 4.8)

Table 4.6: Weights of Commodities for Prioritisation Purposes

| Priority       | I   | II  | III | IV  |
|----------------|-----|-----|-----|-----|
| ADD Importance | 1   | 0.8 | 0.6 | 0.4 |
| Research needs | 0.8 | 0.6 | 0.4 | 0.2 |

Table 4.7: Total Commodity Scores for Prioritisation and Ranking at both ADD and National Levels

| COMMODITY        | SVADD | BLADD | MADD | SLADD | KRADD | MZADD | LADD | KADD | Total | Mean | Rank |
|------------------|-------|-------|------|-------|-------|-------|------|------|-------|------|------|
| Poultry          | 1.8   | 1.8   | 1.8  | 1.8   | 1.8   | 1.8   | 1.6  | 1.8  | 14.2  | 1.78 | 1    |
| Maize            | 1.8   | 1.8   | 1.6  | 1.6   | 1.8   | 1.8   | 1.6  | 1.8  | 13.8  | 1.73 | 2    |
| Vegetables       | -     | 1.8   | 1.6  | 1.6   | 1.8   | 1.6   | 1.8  | 1.6  | 11.8  | 1.69 | 3    |
| Cattle           | 1.6   | 1.8   | 1.8  | 1.8   | 1.8   | 1.6   | 1.6  | 1.2  | 13.2  | 1.65 | 4    |
| Cassava          | 1.0   | 1.8   | 1.8  | 1.8   | 1.8   | 1.8   | 1.4  | 1.8  | 13.2  | 1.65 | 4    |
| Groundnuts       | 1.4   | 1.6   | 1.8  | 1.8   | 1.6   | 1.6   | 1.4  | 1.8  | 13.0  | 1.63 | 5    |
| Tropical Fruits  | 1.8   | 1.8   | 1.4  | 1.4   | 1.8   | 1.6   | 1.8  | 1.2  | 12.8  | 1.60 | 6    |
| Goats            | 1.6   | 1.6   | 1.6  | 1.6   | 1.4   | 1.8   | 1.4  | 1.4  | 12.4  | 1.55 | 7    |
| Beans            | 1.0   | 1.8   | 1.2  | 1.2   | 1.6   | 1.8   | 1.8  | 1.8  | 12.2  | 1.53 | 8    |
| Cotton           | 1.4   | 1.2   | 1.8  | 1.8   | 1.6   | 1.6   | 1.2  | 1.6  | 12.2  | 1.53 | 8    |
| Rice             | 1.0   | 1.4   | 1.6  | 1.6   | 1.8   | 1.6   | -    | -    | 9.0   | 1.50 | 9    |
| Sweet Potato     | 1.6   | 1.4   | 1.4  | 1.4   | 1.2   | 1.4   | 1.8  | 1.8  | 12.0  | 1.50 | 9    |
| Sunflower        | 1.0   | 1.6   | 1.6  | 1.6   | 1.2   | 1.6   | 1.4  | 1.4  | 11.4  | 1.43 | 10   |
| Millet           | 1.8   | 1.2   | 1.2  | -     | 1.6   | 1.2   | 1.6  | 1.4  | 10.0  | 1.43 | 10   |
| Soybeans         | 1.0   | 1.8   | 1.4  | 1.4   | 1.6   | 1.4   | 1.2  | 1.2  | 11.0  | 1.38 | 11   |
| Sheep            | 1.2   | 1.6   | 1.6  | 1.6   | 1.2   | 1.2   | 1.2  | 1.4  | 11.0  | 1.38 | 11   |
| Pigeonpeas       | 1.4   | 1.6   | 1.6  | 1.6   | 1.2   | 0.8   | 1.2  | -    | 9.4   | 1.34 | 12   |
| Pastures         | 1.2   | 1.2   | -    | 0.8   | 1.6   | 1.4   | 1.6  | 1.6  | 9.4   | 1.34 | 12   |
| Sorghum          | 1.8   | 1.2   | 1.4  | 1.4   | 1.4   | 0.8   | -    | -    | 8.0   | 1.33 | 13   |
| Coffee           | -     | 0.8   | -    | -     | 1.4   | 1.8   | 1.2  | 1.4  | 6.6   | 1.32 | 14   |
| Citrus           | -     | 1.8   | -    | 1.0   | 1.6   | 1.0   | -    | 1.2  | 6.6   | 1.32 | 14   |
| Deciduous Fruits | -     | 1.4   | 0.6  | -     | 1.2   | 1.6   | 1.8  | 1.2  | 7.8   | 1.30 | 15   |
| Cowpeas          | 1.6   | 1.2   | 1.4  | 1.0   | 1.2   | 1.2   | 1.4  | 1.2  | 10.2  | 1.28 | 16   |
| Pigs             | 1.2   | 1.2   | 1.4  | 1.0   | 1.4   | 1.4   | 1.6  | 1.0  | 10.2  | 1.28 | 16   |
| Rabbits          | -     | -     | 1.4  | 1.4   | 1.2   | 1.2   | 1.2  | 1.2  | 7.6   | 1.27 | 17   |
| Potato           | -     | 1.6   | 0.8  | 0.8   | 1.0   | 1.4   | 1.8  | 1.4  | 8.8   | 1.26 | 18   |
| Tree Nuts        | -     | 1.4   | 0.8  | 0.6   | 1.4   | 1.4   | 1.2  | 1.6  | 8.4   | 1.20 | 19   |
| Wheat            | -     | 1.4   | -    | -     | -     | -     | 1.2  | 1.0  | 3.6   | 1.20 | 19   |
| Chickpeas        | -     | 1.2   | 1.2  | -     | -     | -     | -    | -    | 2.4   | 1.20 | 19   |
| Spices           | -     | 1.2   | 1.2  | 1.2   | 1.2   | 0.8   | 1.4  | -    | 7.0   | 1.17 | 20   |
| Groundbeans      | -     | 0.6   | 0.8  | 0.8   | 1.2   | 1.4   | -    | 1.0  | 5.8   | 0.97 | 21   |
| Dolichos Beans   | 1.0   | -     | 0.8  | 0.6   | -     | 0.6   | -    | -    | 3.0   | 0.75 | 22   |
| Sesame           | 1.0   | 0.6   | 0.6  | -     | -     | -     | -    | -    | 2.2   | 0.73 | 23   |
| Grams            | 0.6   | 0.6   | 0.8  | 0.8   | -     | -     | -    | -    | 2.8   | 0.70 | 24   |

Table 4.8: Priorities according to Importance and Research Needs at ADD Level

**BLANTYRE ADD**

| Priority I      | Priority II | Priority III | Priority IV |
|-----------------|-------------|--------------|-------------|
| Cassava         | Pigeonpeas  | Cotton       | Rabbits     |
| Vegetables      | Sunflower   | Pasture      | Groundbeans |
| Soyabeans       | Potato      | Spices       | Grams       |
| Tropical Fruits | Citrus      | Sorghum      | Guar beans  |
| Cattle          | Sheep       | Pigs         | Sesame      |
| Chickens        | Rice        | Millet       | Turkeys     |
| Maize           | Groundnuts  | Cowpeas      |             |
| Beans           | Goats       | Chickpeas    |             |
| Sweet potato    |             |              |             |
| Tobacco         |             |              |             |
| Tree nuts       |             |              |             |
| Mushroom        |             |              |             |

**KARONGA ADD**

| Priority I      | Priority II   | Priority III | Priority IV      |
|-----------------|---------------|--------------|------------------|
| Vegetable       | Cotton        | Goats        | Spices           |
| Cattle          | Soyabeans     | Tree nuts    | Sweet potato     |
| Chickens        | Pastures      | Coffee       | Rabbits          |
| Maize           | Beans         | Pigeonpeas   | Sunflower        |
| Cassava         | Groundnuts    | Sorghum      | Groundbeans      |
| Tropical Fruits | Tobacco       |              | Potato           |
| Rice            | Citrus        |              | Sheep            |
| Poultry         | Finger Millet |              | Temperate Fruits |
| Cowpeas         |               |              |                  |

**KASUNGU ADD**

| Priority I   | Priority II | Priority III  | Priority IV     |
|--------------|-------------|---------------|-----------------|
| Cassava      | Cotton      | Sunflower     | Cattle          |
| Maize        | Tree Nuts   | Potato        | Soybeans        |
| Groundnuts   | Vegetables  | Finger Millet | Tropical Fruits |
| Sweet Potato | Pastures    | Coffee        | Pigs            |
| Beans        | Tobacco     | Goats         | Rabbits         |
| Chickens     |             | Sheep         | Groundbeans     |
| Temp. Fruits |             |               |                 |
| Cowpeas      |             |               |                 |
| Citrus       |             |               |                 |
| Sugarcane    |             |               |                 |

**LILONGWE ADD**

| Priority I       | Priority II | Priority III | Priority IV |
|------------------|-------------|--------------|-------------|
| Vegetables       | Cattle      | Cassava      | Cotton      |
| Tropical Fruits  | Chickens    | Spices       | Soybeans    |
| Beans            | Pigs        | Goats        | Pigeonpeas  |
| Sweet Potato     | Millet      | Groundnuts   | Rabbits     |
| Potato           | Pasture     | Cowpeas      | Tree Nuts   |
| Temperate Fruits | Maize       | Sunflower    | Sheep       |
| Tobacco          | Coffee      |              |             |
| Donkeys          |             |              |             |
| Work Oxen        |             |              |             |

**MACHINGA ADD**

| Priority I       | Priority II | Priority III    | Priority IV |
|------------------|-------------|-----------------|-------------|
| Cassava          | Vegetables  | Soyabeans       | Spices      |
| Cotton           | Rice        | Tropical Fruits | Beans       |
| Cattle           | Goats       | Sweet potato    | Pasture     |
| Chickens         | Maize       | Sorghum         | Pigs        |
| Groundnuts       | Pigeonpeas  | Rabbits         | Tree nuts   |
| Tobacco          | Sunflower   | Sheep           | Groundbeans |
| Potato           |             |                 | Grams       |
| Velvet beans     |             |                 |             |
| Doves            |             |                 |             |
| Castor           |             |                 |             |
| Dolichos beans   |             |                 |             |
| Temperate fruits |             |                 |             |

**MZUZU ADD**

| Priority I | Priority II      | Priority III | Priority IV |
|------------|------------------|--------------|-------------|
| Cassava    | Cotton           | Soybeans     | Spices      |
| Cattle     | Vegetables       | Pastures     | Sorghum     |
| Chickens   | Tropical Fruits  | Sweet Potato | Pigeonpeas  |
| Goats      | Rice             | Pigs         | Rabbits     |
| Beans      | Groundnuts       | Tobacco      | Millet      |
| Coffee     | Sunflower        | Tree Nuts    | Cowpeas     |
| Maize      | Temperate Fruits | Groundbeans  | Citrus      |
| Potato     | Dolichos Beans   |              |             |

## SHIRE VALLEY ADD

| Priority I      | Priority II  | Priority III | Priority IV |
|-----------------|--------------|--------------|-------------|
| Chickens        | Cotton       | Cassava      | Grams       |
| Tropical Fruits | Cattle       | Soyabeans    | Vegetables  |
| Maize           | Goats        | Pastures     | Spices      |
| Sorghum         | Groundnuts   | Rice         | Tree nuts   |
| Tobacco         | Sweet Potato | Beans        | Groundbeans |
| Pearl Millet    | Pigeonpeas   | Pigs         | Doves       |
| Guar beans      | Rabbits      | Sunflower    | Ducks       |

## SALIMA ADD

| Priority I | Priority II     | Priority III | Priority IV |
|------------|-----------------|--------------|-------------|
| Cassava    | Tropical Fruits | Citrus       | Sunflower   |
| Cotton     | Rice            | Beans        | Tobacco     |
| Vegetables | Spices          | Groundnuts   | Cashew      |
| Cattle     | Goats           | Sweet potato | Groundbeans |
| Chickens   | Maize           | Sorghum      | Potato      |
| Soyabean   | Sesame          | Pigeonpeas   | Turkeys     |
| Pastures   |                 | Pigs         | Sheep       |
| Rabbits    |                 |              |             |
| Millet     |                 |              |             |
| Ducks      |                 |              |             |
| Pigeons    |                 |              |             |

## 4.8 COMMODITY PRIORITY SETTING AT NATIONAL LEVEL ACCORDING TO ADDs

To reflect the thinking and experience of the extension personnel at ADD level as compared to that by DAR (Table 4.3), it was decided to generate commodity priorities at national level by using information in Table 4.8.

The total scores for each commodity across the ADDs were combined to get a mean score which reflects the rank at the national level according to ADD (Table 4.7). The crop/livestock with the highest score (1.78 for poultry) was ranked No.1 while that with the least score (0.70 for grams) was assigned the last rank of No.34. Crops or livestock from ranks 1 through 9 were assigned to Priority I; 10 through 15 to Priority II; 16 through 20 to Priority III and anything below 20 to Priority IV (Table 4.9). The crops/livestock are placed in four priorities groups in the descending order of importance within each priority group.

Table 4.9: Priority Setting at National Level According to ADDs

| Priority I      | Priority II      | Priority III | Priority IV    |
|-----------------|------------------|--------------|----------------|
| Poultry         | Sunflower        | Cowpeas      | Groundbeans    |
| Maize           | Millet           | Pigs         | Dolichos beans |
| Vegetables      | Soyabeans        | Rabbits      | Sesame         |
| Cattle          | Sheep            | Potato       | Grams          |
| Cassava         | Pigeonpeas       | Treenuts     | Mushroom       |
| Groundnuts      | Pastures         | Wheat        | Doves          |
| Tropical Fruits | Sorghum          | Chickpea     | Turkeys        |
| Goats           | Coffee           | Spices       | Donkey         |
| Beans           | Citrus           | Castorbean   | Sugarcane      |
| Cotton          | Deciduous Fruits |              | Work-oxen      |
| Rice            |                  |              | Guarbeans      |
| Sweet potato    |                  |              |                |

There are some similarities between the priorities set by DAR staff in Table 4.3 and those by extension personnel in Table 4.9. Both groups agree that tropical fruits, cattle, cotton, poultry, rice, vegetables and groundnuts belong to Priority I. Maize and cassava are placed in Priority II by DAR while they are in Priority I by ADD. The priority differences observed reflect the fact that researchers and extension personnel placed differing weights on importance of commodities to the nation and research needs.

## 4.9 COMMODITY PRIORITY SETTING AT NATIONAL LEVEL AS A COMBINED EFFORT BY DAR AND ADD MANAGEMENT.

It is worth noting that extension personnel are key figures in identifying problems and constraints while researchers are more knowledgeable about what is achievable through research. For this reason, an attempt was made to merge the priority lists made by DAR and ADD personnel to come up with one national priority list as follows:

- the crop and livestock ranking by DAR was multiplied by the ranking by ADD to get product scores for each commodity (Appendix IX).
- crops/livestock with total scores from 0 to 100 were placed in Priority I, from 101 to 300 in Priority II, from 301 to 500 in Priority III, and from 501 to 800 in Priority IV as shown in Table 4.10 with some more details in Appendix X.



Table 4.10: Crop and Livestock Combined DAR and ADD Priority list at National Level.

| Priority I      | Priority II    | Priority III     | Priority IV         |
|-----------------|----------------|------------------|---------------------|
| Minor           | Non-DAR        | Soybeans         | Pastures            |
| Crop/Livestock  | Beans          | Deciduous Fruits | Sorghum and Sesame  |
| Mandate         | Tea            | Millet           | Wheat               |
| Poultry         | Pigeonpeas     | Spices           | Chickpeas and Grams |
| Groundbeans     | Dolichos Beans | Cowpeas          | Dove                |
| Tropical Fruits | Tree Nuts      | Sheep            | Turkeys             |
| Pigs            | Sunflower      | Potato           | Donkey              |
| Sugarcane       | Goats          |                  | Work oxen           |
| Cattle          | Sweet Potato   |                  |                     |
| Tobacco         |                |                  |                     |
| Vegetables      |                |                  |                     |
| Caster Bean     |                |                  |                     |
| Maize           |                |                  |                     |
| Coffee          |                |                  |                     |
| Cotton          |                |                  |                     |
| Groundnuts      |                |                  |                     |
| Citrus          |                |                  |                     |
| Rice            |                |                  |                     |
| Cassava         |                |                  |                     |

**Note:** Crops within each priority group are listed in the order of their priority.

The contents of Table 4.10 reflect the views, perspectives and experiences of both DAR and ADD management on crop and livestock production and research priorities.

In summary, the DAR resources ought to be allocated to commodities according to their priority as established in Table 4.10. Poultry, tropical fruits, cattle and vegetables should proportionally receive more resources than maize. The most important commodity should, therefore, be followed by coffee, cotton, groundnuts etc., until the least crop (chickpeas) is funded. Individual ADDs also have their own specific priorities and these have to be addressed at ADD level as well. The priority list by all ADDs, DAR, combined ADD and DAR, minor crops and non-DAR mandate crops are shown in Appendix 1.

It is important that the DAR establishes its own crop or livestock priorities and allocate its limited resources among competing projects objectively in order to attain the desired national goals and objectives. This exercise aims at providing a logical basis for strategic allocations of human, financial, physical, and capital resources within the Department until year 2,000. The priorities have been made carefully and are transparent.

The transparency of the established priorities coupled with the contribution from the most senior members of ADDs will enhance the credibility of DAR research among policy makers and donor agencies. This priority setting is only a guideline for DAR to justify long and short-term allocations of resources among individual research teams. Due consideration should be given to specific commodities which are naturally more expensive to research on e.g. cattle and cotton. Furthermore, the research/technical constraints within each commodity be considered especially regarding the degree of difficulty involved in overcoming the constraints.

#### 4.10 Future Suggestions on Priority Setting

Priorities should be reviewed and revised yearly, as research is a dynamic process and changes may occur. As production problems are solved with the appropriate generation of new technologies. On the other hand, new problems may arise that require research attention. Furthermore, economic and policy factors may also change which could bring about a completely different set of circumstances in favour of or against a particular commodity or class of commodities.

To address weaknesses in the current methodologies of priority setting, it is suggested that future reviews of research priorities should include farmer involvement to establish demand for specific technologies, categorisation of food, cash crops, livestock and potential commodities to allow for prioritisation of commodities in the same category, prioritisation of research activities or areas to address specific identified constraints and relationships. Combinations between commodities need to be highlighted e.g. cattle and pastures, poultry and soya beans, maize and beans, etc.

## CHAPTER 5

### RESEARCH BUDGET, INFRASTRUCTURE AND MANPOWER PROJECTIONS

#### 5.1 INTRODUCTION

The critical requirements for effective agricultural research are the provision of funds and facilities that enable research scientists to carry out their functions efficiently. In addition, research must be conducted by well-trained scientists who should be given opportunities for continued improvement in their research skills. Each research scientist must be strengthened by a team of sufficiently-trained technical support staff. Research scientists should be provided with adequate instruments, equipment and other facilities for their work. To ensure continuity and completeness of research programmes, constant and long-term financial support and timely release of funds for expenditure are required.

#### 5.2 DAR'S FINANCIAL SOURCES

The two major sources of funds for DAR's research activities are revenue and development accounts. However, some programmes within some commodity teams receive financial assistance from private and external sources through project submissions.

##### 5.2.1 Revenue Funds

Table 5.1 shows the revenue financial resources of the DAR in 1994/95 financial year as a component of total government budget. Measured against the Agricultural GDP, it is desirable that research financial support be at least 1% of the AGDP. The 1994/95 allocation shows that it was only 0.78% of the AGDP and only 12% of the Ministry of Agriculture and Livestock Development's budget.

This was, therefore, less than the required allocation, and the lack of allocation of revenue funds for capital formation in this year was a further shortfall in the allocation required for effective running of research activities. Although capital formation is normally borne on Development Funds, it is essential to plan for such costs even on Revenue budget to sustain the activities of the department.

Table 5.1: DAR's Financial Resources in the 1994/95 Financial Year as a Component of Total Government Expenditure.

| REVENUE ACCOUNT*                         | MK<br>(MILLION) | %<br>Total<br>Govt.<br>Budget | %<br>AGDP<br>Budget | %<br>DAR<br>Budget | %<br>MOALD<br>Budget |
|--|-----------------|-------------------------------|---------------------|--------------------|----------------------|
| Total Government Budget,                 | 2045.13         |                               |                     |                    |                      |
| Agricultural GDP                         | 1375.50         |                               |                     |                    |                      |
| Allocation to MOALD                      | 90.00           | 4.40                          | 6.54                |                    |                      |
| Allocation to Agricultural<br>Research   | 10.67           | 0.52                          | 0.78                |                    | 11.86                |
| Total Salaries                           | 4.59            | 0.22                          | 0.33                | 43.0               | 5.10                 |
| Total Goods and Services                 | 6.08            | 0.30                          | 0.44                | 56.9               | 6.76                 |
| Total Capital Formation                  | 0.0             | 0.0                           | 0.0                 | 0.0                | 0.0                  |
| <b>DEVELOPMENT ACCOUNT **</b>            |                 |                               |                     |                    |                      |
| Agricultural services<br>programme (ASP) | -               |                               |                     |                    |                      |
| Research Component                       | 146.08          |                               |                     |                    |                      |
| - Expenditure in 1994/95                 | 9.25            |                               |                     |                    |                      |
| - Percent of Total ASP Budget            | 6.33            |                               |                     |                    |                      |

SOURCE: \* Government of Malawi Approved Expenditure from Revenue Account for the Financial year 1994/95.  
\*\* Approved Expenditure from Development Account for the Financial Year 1994/95.

##### 5.2.2 Development Funds

As stated in section 5.2, DAR has been a recipient of donor funds from the international lending and aid organisations and agencies such as the World Bank (through IDA), UNDP, IDRC, Rockefeller Foundation and ADB. These are funds provided for technical assistance, human and physical resources' development. During the 1993 to 1999 period, ASP will provide some funding for operational costs which has not been the case in the past. The funds will contribute about 6 % of DAR's budget on revenue account.

##### 5.2.3 Other Sources

Some DAR research projects benefit from financial contributions from a number of independent bodies, IARCs, and the private sector. Such organisations have particular interest in specific programmes. For instance, the Carlsberg Malawi Brewery Limited financed several years' of research on barley to test introduced varieties for adaptation to Malawi conditions. The National Seed and Cotton Milling Company of Malawi pays for the costs incurred by the Seed Services Commodity Team in seed certification activities. Some IARCs, like ICRISAT, CIMMYT, IITA, ICRAF and ILRI also have special interests in research projects within their mandate and sometimes do support DAR's programmes which are related to their activities. Often the support comes in the form of materials and equipment necessary for carrying out specific tasks.

### 5.3 DAR's BUDGET PROJECTIONS

The budget projections per commodity team for operational costs for all cost items of the department are based on the 1994/95 expenditure levels. They show the expected increase in the costs of its activities over a period of six years (Tables 5.2 and 5.3). Projected future priorities and other resources' needs have been taken into account in making these projections.

The wide variation in budget projections among commodities, indirectly shows the priorities of the commodity teams. However, some of the commodities, such as cotton and livestock, have a large budget not necessarily because they are highly prioritised but because they are naturally expensive. Besides, some commodity teams such as the Agribusiness, forestry and Root and Tuber crops benefit from donor funds.

These projections reflect the minimal rate of increase of expenditures in relation to the growth rate of research activities. There are two reasons: firstly, the rate of increase of expenditure does not take into account unpredictable changes of the strength of the local currency; secondly, the growth rate of research activities is affected by seasonal factors. Nevertheless, on the assumption that conditions affecting the allocations of funds in 1994/95 budget do not change, the projections show what government is expected to allocate to DAR over the six year period.

The inferences drawn from Table 5.1 clearly show that considerable effort should be made by government to increase funding for the continuity of research projects. Stable and reliable funding are as important in research as the amounts of funding. To this effect it is hoped that the ARC would focus its attention on funds allocated to DAR.

Table 5.2: DAR's Commodity Budget Projections ( 000'MK) for 1994-2000

| COMMODITY               | FINANCIAL YEAR |         |         |         |         |           |
|-------------------------|----------------|---------|---------|---------|---------|-----------|
|                         | 1994/95        | 1995/96 | 1996/97 | 1997/98 | 1998/99 | 1999/2000 |
| Maize                   | 374            | 411     | 452     | 497     | 547     | 602       |
| Rice                    | 281            | 309     | 339     | 373     | 411     | 452       |
| Sorghum / Millet        | 129            | 142     | 156     | 172     | 189     | 208       |
| Wheat/Barley            | 80             | 88      | 97      | 107     | 118     | 130       |
| Temperate Fruits        | 243            | 267     | 294     | 323     | 255     | 281       |
| Tropical Fruits         | 251            | 276     | 304     | 334     | 367     | 404       |
| Tree nuts               | 138            | 152     | 167     | 184     | 202     | 222       |
| Coffee                  | 155            | 171     | 188     | 207     | 228     | 251       |
| Roots & Tubers          | 521            | 573     | 630     | 693     | 762     | 838       |
| Vegetables              | 119            | 131     | 144     | 158     | 174     | 191       |
| Groundnuts              | 210            | 231     | 254     | 279     | 307     | 338       |
| Cotton                  | 410            | 451     | 496     | 546     | 600     | 660       |
| Beans                   | 203            | 223     | 245     | 270     | 297     | 326       |
| Oilseeds                | 84             | 92      | 102     | 112     | 123     | 135       |
| Other Grain Legumes     | 197            | 216     | 238     | 262     | 288     | 317       |
| Livestock               | 318            | 350     | 385     | 423     | 416     | 512       |
| Pastures                | 65             | 71      | 79      | 86      | 95      | 105       |
| Soils Fertility         | 311            | 342     | 376     | 413     | 455     | 500       |
| Soil Microbiology       | 78             | 86      | 94      | 104     | 114     | 126       |
| Soil Survey             | 63             | 69      | 76      | 84      | 92      | 102       |
| Irrig. & Drainage       | 69             | 76      | 84      | 92      | 101     | 111       |
| Farm Machinery          | 79             | 83      | 91      | 100     | 110     | 121       |
| Agroforestry            | 57             | 63      | 69      | 76      | 84      | 92        |
| Crop Storage & P.Insp   | 113            | 124     | 136     | 150     | 165     | 181       |
| Seed Services           | 252            | 277     | 305     | 335     | 369     | 406       |
| Plant Genetic Resources | 107            | 117     | 129     | 142     | 156     | 172       |
| Entomology              | 125            | 137     | 151     | 166     | 182     | 201       |
| Pathology & Quarantine  | 155            | 170     | 187     | 206     | 226     | 249       |
| Library                 | 195            | 215     | 236     | 260     | 286     | 314       |
| Nematology              | 30             | 33      | 36      | 40      | 44      | 48        |
| AGREDAT                 | 122            | 134     | 147     | 162     | 178     | 196       |
| TOTAL                   | 5534           | 6080    | 6687    | 7356    | 7941    | 8791      |

Source: Approved DAR Commodity Expenditures

Assumption: 50% inflation rate in 1994/95 financial year.

: Normal government budgetary increase of 10% annually.

The projected revenue budget for all DAR's cost items in Table 5.3 were also based on a 10% pro-rata growth rate. Since sole reliance on Development Funds for capital formation is non-sustainable, these projections have included this cost item. The projections in Table 5.3 further show that the ratio of operational costs to salaries and other over-head cost items is 1:2.5 against the desirable ratio of 3:2. It is important that this ratio is reversed for effective running of research activities. This can be done through reduction in non-established staff, government should be committed to targeting funds to scientists and scientists should seek funds for their research activities independently.

Table 5.3: DAR's Revenue Budget Projections for the next Five Years (000'(MK)) from the 1994/95 Fiscal Year.

|                       | 1994/95      | 1995/96      | 1996/97      | 1997/98      | 1998/99      | 1999/2000    | TOTAL         |
|-----------------------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|
| Estab. staff salaries | 5608         | 6169         | 6786         | 7464         | 8211         | 9032         | 43270         |
| Non Estab. salaries   | 5963         | 6559         | 7215         | 7937         | 8730         | 9604         | 46008         |
| Goods and services    | 14157        | 15573        | 17130        | 18843        | 20727        | 22800        | 109230        |
| Capital Transfer      | 725          | 798          | 877          | 965          | 1062         | 1168         | 5595          |
| Capital Formation*    | 22535        | 24789        | 27267        | 29994        | 32994        | 36293        | 173872        |
| <b>TOTAL</b>          | <b>48988</b> | <b>53888</b> | <b>59275</b> | <b>65203</b> | <b>71724</b> | <b>78897</b> | <b>377975</b> |

Source: Approved DAR Commodity Expenditures

N/B.: 1994/95 Expenditures are the base line. The figures were projected by 10% increase every subsequent year

#### 5.4 PROPOSED MEANS OF IMPROVING DAR'S FUNDING: CREATION OF AN AGRICULTURAL RESEARCH AND DEVELOPMENT FUND (ARDF)

The key to achieving sustainability and productivity of agricultural research, in the light of declining budgetary allocation from government, is to create an independent legally-recognised mechanism of generating incremental funding for agricultural research activities. There are several opportunities upon which a sound agricultural research funding system could be built. The government has demonstrated its will to improve research by its recent approval of a new establishment for the department although its resources can still not meet the operational budget of the department. There is need to establish an ARDF to sustain the execution of strategic research and development activities. The fund would minimise the effects of declining funding so that the continuity of Research and Development activities do not suffer.

The ARDF will be sustained through the following funding mechanisms:

- (i) annual subventions from Treasury;
- (ii) endowments: this is a revenue-yielding asset which should be considered to provide financial stability to the Department;
- (iii) check-off Programme: this is a voluntary funding system by private organisations, donors (local and foreign), Science Foundations and users of the technologies generated by the Department;
- (iv) patents and Liabilities: in this scheme new technologies will be patented (e.g. new crop varieties) so that some of the revenues accruing from the use of such technologies are re-invested into the programme concerned. There is need to conduct in-depth studies to establish the implementation of ARDF and how different fund-raising mechanisms could be utilised; and
- (v) produce and services should be sold or offered at commercial rates and revenue accrued should be deposited in the ARDF.

#### 5.5 DAR'S MANPOWER PROJECTIONS

The strength of any agricultural research system depends on the quality of the research staff. Malawi is currently on a sound track for developing its research manpower. However, there is still a need for more specialised research programmes of national importance to complement the existing programmes and their well-trained technical and support staff. The current professional staff positions are shown under 1995 while the projected additional requirements are under year 1996 to the year 2,000 of Table 5.4.

To make these manpower projections, three factors: mandatory retirement age, replacement of scientists who have left the department during the last two years and growth of activities within each commodity group were considered. From 1998 to the year 2,000, some scientists will have reached the age of 55 years; and these together with those who have left the department for greener pastures need to be replaced. There is anticipated and planned growth within all commodities and growth resulting from the creation of new commodity teams. Both of these scenarios will require new scientists to be recruited.

A notable increase in staff requirements for some commodities need some explanation: the 100% staff increase required for livestock reflects the new commodities and the emphasis this commodity deserves more than 110% increase in Agricultural Technical Services is due to the high numbers of social economists who have quit the department that need to be replaced.

**Table 5.5: DAR's Additional Professional Staff Projection for the Period 1996 - 2000**

| COMMODITY GROUP                     | YEAR |      |      |      |      |      | Total |
|-------------------------------------|------|------|------|------|------|------|-------|
|                                     | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |       |
| Cereals                             | 12   | 3    | 3    | 0    | 0    | 0    | 6     |
| Legumes, Fibres and Oilseeds        | 18   | 2    | 2    | 0    | 0    | 0    | 4     |
| Horticulture                        | 18   | 1    | 1    | 0    | 0    | 0    | 2     |
| Soils & Agricultural Engineering    | 16   | 0    | 0    | 0    | 0    | 0    | 0     |
| Livestock & Pastures                | 6    | 4    | 4    | 0    | 0    | 0    | 8     |
| Agricultural Technical Services     | 9    | 4    | 4    | 2    | 0    | 0    | 10    |
| Plant Protection                    | 6    | 2    | 2    | 0    | 0    | 0    | 4     |
| Administrative Staff Hqrs. Stations | 5    | 4    | 0    | 0    | 0    | 0    | 4     |
|                                     | 1    | 13   | 0    | 0    | 0    | 0    | 13    |
|                                     | 91   | 120  | 136  | 138  | 138  | 138  | 142   |

\*:Additional persons needed to be employed over the five years

Note: 1995 column shows the current professional staff level

### 5.5.1 Recruitment and Training

DAR recruits its professional and technical staff mostly from the University of Malawi and the Natural Resources College. Most of the new DAR recruits generally have little working experience. With the development of job descriptions for various groups of researchers and their support staff, it has been possible for the department to arrange for appropriate in-service training and short courses at IARCs and other overseas research institutions.

More opportunities for in-service training at the national institutions and the IARCs should be sought and taken to upgrade the knowledge of these staff members for an effective contribution to research. DAR should also strengthen its training in management, planning, budgeting, monitoring and evaluation of research activities and institutions, to ensure efficient utilisation of the limited resources.

### 5.6 DAR's PHYSICAL INFRASTRUCTURE PROJECTIONS

DAR has adequate physical facilities to carry out most of the planned experimental work. Currently, DAR's network of research, sub research stations and experimental sites has sufficient laboratory, office space and library facilities. However, specialised equipment and structures and number of residential houses for staff at all levels are still inadequate. To enhance field work and other research activities, periodic review of the number and condition of plants and vehicles is required.

## CHAPTER 6

### DESIRED ORGANISATIONAL CHANGES AND CAREER STRUCTURE

#### 6.1 INTRODUCTION

Substantial and sustainable improvements in DAR organisational structure and its research systems are essential for sustainable development of the much needed scientific and technological information focused efficiently on solving priority agro-economic problems. The commodity team approach of research has highlighted the need for several additional structural and organisational changes. Some of the commodity teams are too broad, covering many disciplines. This does not allow detailed coverage of research areas as required by the present reorganisation. Some of the commodity teams do not have adequate staff and funding to carry out research. It is also important that the DAR's career structure be improved through broadening and upgrading of the current organisational structure. This will cater for the large number of the highly trained and long-serving staff members.

#### 6.2 DESIRED RESEARCH ORGANISATIONAL STRUCTURE

Organisational changes are desired in some of DAR's Commodity groups as follows:

##### 6.2.1 Group of Commodities

##### (a) Livestock and Pastures Commodity Group

At the moment the Livestock Commodity Team is large, with several distinct sections grouped together. It is evident that the Livestock Commodity Team would be better served if more distinct teams were established. It is, therefore, proposed that the Livestock and Pastures Commodity Group be re-organised as follows:

- (i) Large Ruminants and Feeds Commodity Team to be responsible for all research on beef, dairy cattle, and animal draught power. The major disciplines are;
  - Breeding
  - Reproductive Physiology
  - Nutrition
- (ii) Small Ruminants and Feeds Commodity Team, to be responsible for research on sheep and goats under the following disciplines;
  - Breeding
  - Reproductive Physiology
  - Nutrition
- (iii) Monogastric Commodity Team, to be responsible for all research work on poultry and pigs, and non-conventional livestock species, such as pigeons, guinea fowls, rabbits and ducks in the following disciplines;
  - Breeding
  - Reproductive Physiology
  - Nutrition
- (iv) Pastures and Range Management Commodity Team, to be responsible for cultivation practices of pastures and their sustainable management. The major disciplines are:
  - Agronomy
  - Pasture and Range Management

##### (b) Horticulture Commodity Group

Presently, some aspects of horticulture are not being fully addressed and there is need to create one more commodity team in the group:

##### Floriculture and Plant Propagation Commodity Team

Currently, Malawi imports and exports some cut flowers. There is evidence that cut flower production could be increased to reduce, and eventually eliminate, flower imports. This will be part of the diversification programme. There is need for establishing a commodity team to conduct research and develop technologies for cut flower production and plant propagation in the country.

##### (c) Technical Services Commodity Group

Food Science and Technology Commodity Team.

There are enormous losses in fresh produce quality and quantity due to poor handling and processing. Since most produce are highly perishable, there is a great need for careful and efficient handling before consumption, sale or processing. The technology gap in handling and processing of fresh produce can adequately be addressed by DAR if a commodity team was set up to specifically study the issues of post-harvest handling and processing for all produce.

### 6.2.2 On-Farm Testing

Usually, technologies developed by DAR take a long time to reach the end-user because of the time lag between on-station and on-farm experimentation. The current practice is to have a technology developed and evaluated for three years at research stations followed by another three years of evaluation on farmers' fields before it is finally released to the farming community. This might be a logical procedure for technologies developed by some disciplines such as plant breeding, pathology and entomology for plant protection because of some technicalities and dangers of exposing such technologies to the farming community at a very early stage. However, for technologies developed by agronomists, for example, the procedure could be modified: first season should concentrate on on-station evaluation but in the second season, the few promising "candidate technologies" should go into on-farm testing programmes while a full set of "test technologies" is repeated in on-station testing. In the third season of on-station testing, a researcher will be "fine-tuning" his/her "candidate technology (ies)." The fourth season will be solely for on-farm verification and/or demonstration. Thus, instead of six years, it will now take only four years/seasons for a technology to reach the end user.

### 6.2.3 Specialised Laboratories

It is recommended that DAR should establish specialised laboratories to cater for specific interests.

#### (a) Food Science Laboratory

This specialised laboratory would be involved in research on dried and fresh produce handling, packaging, shelf-life and processing. This obviously requires a well-equipped specialised laboratory. The laboratory would support the research activities in Food Science and Technology.

#### (b) Tissue Culture Laboratories

To assist the adoption of technology, it is necessary to achieve multiplication and distribution of disease-free planting material quickly and efficiently. The advent of biotechnology ensures fast multiplication of disease-free healthy material. This has special use for multiplication of crops such as fruit trees, cassava and vegetables, whose distribution is normally hampered by bacterial and viral infections. It is imperative, that DAR establishes and adequately equips tissue culture laboratories at major research stations where research on multiplication of specific crops could be undertaken.

#### (c) Fibre and Yarn Testing Laboratory

At present, there are no fibre and yarn testing facilities in DAR. All tests of materials from the cotton research programme are done overseas at very a high cost. The establishment of a miniature fibre and yarn testing, spinning and weaving laboratory at Makoka Experimental Station would greatly save foreign exchange and enable the cotton research programme to effectively screen experimental materials. Such a laboratory would also provide service and facilities for testing textile material from the private sector at a cost.

#### (d) Mushroom Spawn Laboratory

Mushroom spawn production programme is at present under the Plant Pathology Commodity Team. The facilities are rudimentary and the staff is working on part-time basis. A lot of requests for spawn and mushroom cannot be met because of inadequate facilities and inadequately-trained staff. There is need to establish a fully-fledged laboratory purely for research in media production and well-trained staff to produce spawn. This laboratory has to be under the Horticulture Commodity Group.

## 6.3 DAR'S CAREER STRUCTURE DEVELOPMENT

A sound and effective management system provides its personnel with incentives, and a clear career development path. However, the current DAR's career structure has poor incentives and fails to reward scientific competence adequately. The career structure is also very restrictive and inflexible and does not adequately cater for the large number of the highly trained and experienced members of staff. In comparative terms, it is evident that DAR's personnel are not advancing in career as much as one would have anticipated considering the highly skilled nature of its personnel and the highly demanding nature of their activities. The costs of such career structure to DAR are heavy and can generally be categorised as follows:

- (a) Low morale of staff is a real problem in DAR where the call on its staff members' creativity and use of initiative is high. Scientists do not receive adequate recognition for their work and this is affecting their performance negatively. This has invariably resulted in inefficiency and a concomitant poor performance of the system.
- (b) Staff members leave DAR early, the current attrition rate is very high for the highly trained and experienced personnel who are marketable elsewhere. This situation will get worse as the private sector in Malawi continues to grow and attract such high calibre personnel.
- (c) Potential personnel may not wish to join the Department and DAR will continue to face difficulties in attracting high calibre personnel to fill vacant positions.

To address the problems associated with the DAR career structure, it is recommended that the superscale echelon be broadened to cater for the large number of highly trained and experienced staff members in DAR, also to enhance the career development for research support staff. The broadening of the superscale structure will relieve pressure of work on the few senior staff and will also enhance clear co-ordination of the various diverse commodity groups in DAR.

### 6.3.1 Present Career Structure in the Department of Agricultural Research

The Department of Agricultural Research (DAR) is headed by the Chief Agricultural Research Officer (CARO-P4). He is assisted by two Deputy Chief Agricultural Research Officers (DCARO-P5); one responsible for Research Programmes, and the other for Technical Services, Administration and Training. This level of establishment is inadequate. The CARO and his two deputies carry heavy workloads and have little or no time for planning and directing research programmes. A great deal of their time is spent on responding to crisis management. Research scientists at commodity level are based at research stations as described in section 2.1.2. The current number of established senior posts in DAR is limited to (P8 - P4) a total of (33) compared to the number of scientists working in the Department (Table 6.1.) The structure is restrictive because the highest grade one can aspire for is P4 for the CARO.

In the early part of the 1970s, it was decided that the senior posts in the DAR should "float" instead of being pegged to commodity or discipline. This resulted in a loss of DAR career structure and sowed seeds of frustration and disaffection among members of staff resulting in an increase in the rate of attrition among the research scientists. The floating of posts in DAR has resulted in the random and poor distribution of posts among the commodities and disciplines as shown in Table 6.2. Some commodities have ended up with more senior scientists than others as a result of floating posts. For example; the cereals commodity group has 31% of staff in substantive senior positions unlike horticulture and services with 17% and 23%, respectively. In view of the foregoing, it is proposed to revive the idea of a career structure with posts pegged to disciplines within each commodity group. This structure will minimise disaffection and high attrition rates. To this end, a career structure is proposed as shown in Table 6.3.

Table 6.1. Current DAR's Technical and Professional Establishment as at January, 1995

| Grade | Position               | Number Filled | Vacant | Total Establishment |
|-------|------------------------|---------------|--------|---------------------|
| P4    | CARO                   | 1             | 0      | 1                   |
| P5    | DCARO                  | 3             | 1      | 4                   |
| P6    | ACARO                  | 4             | 3      | 7                   |
| P7    | PARO                   | 2             | 2      | 4                   |
| P8    | SARO                   | 15            | 2      | 17                  |
| PO    | ARO                    | 67            | 19     | 86                  |
| CTO   | Chief Tech. Officer    | 4             | 4      | 8                   |
| STO   | Senior Tech. Officer   | 11            | 5      | 16                  |
| TO    | Technical Officer      | 49            | 19     | 68                  |
| STA   | Senior Tech. Assistant | 24            | 9      | 33                  |
| TA    | Technical Assistant    | 245           | (17)   | 228                 |
| TOTAL |                        | 419           | 47     | 466                 |

- CARO = Chief Agricultural Research Officer.  
 DCARO = Deputy Chief Agricultural Research Officer.  
 ACARO = Assistant Chief Agricultural Research Officer.  
 PARO = Principal Agricultural Research Officer.  
 SARO = Senior Agricultural Research Officer.  
 ARO = Agricultural Research Officer.  
 ( ) = Brackets means over-employment

services. The Ministry of Agriculture and Livestock Development, apart from hosting some of SACCAR's networks/projects such as the SADC/ICRAF Agroforestry Project, SADC/ICRISAT Groundnut Project and the SADC/IITA - SARRNET, is a member of the Board of SACCAR. SACCAR has been instrumental in promoting linkages among the NARs of SADC.





| Commodity Discipline                      | P2 | P3 | P4 | P5 | P6 | P7 | P8 | PO | Total |
|---|----|----|----|----|----|----|----|----|-------|
| Entomologist                              | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 2     |
| Pathologist                               | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     |
| <b>OIL SEEDS</b>                          |    |    |    |    |    |    |    |    |       |
| Breeder                                   | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     |
| Agronomist                                | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 2  | 2     |
| Pathologist                               | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     |
| <b>LIVESTOCK AND PASTURE</b>              |    |    |    |    |    |    |    |    |       |
| <b>LIVESTOCK</b>                          |    |    |    |    |    |    |    |    |       |
| Breeder                                   | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     |
| Nutritionist                              | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 1  | 2     |
| Reprod. Physio                            | 0  | 0  | 0  | 0  | 0  | 0  | 2  | 2  | 2     |
| Past. Agron.                              | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 2  | 2     |
| <b>SOILS AND AGRICULTURAL ENGINEERING</b> |    |    |    |    |    |    |    |    |       |
| <b>SOILS</b>                              |    |    |    |    |    |    |    |    |       |
| Chemist                                   | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 4  | 4     |
| Physicist                                 | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1     |
| Pedologist                                | 0  | 0  | 0  | 0  | 0  | 0  | 2  | 0  | 2     |
| Microbiologist                            | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 2     |
| <b>FARM MACHINERY</b>                     |    |    |    |    |    |    |    |    |       |
| Ag. Engineer                              | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 2  | 3     |
| Mainten. Eng.                             | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     |
| <b>IRRIGATION</b>                         |    |    |    |    |    |    |    |    |       |
| Agronomist                                | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 2  | 2     |
| Engineer                                  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     |
| <b>AGROFORESTRY</b>                       |    |    |    |    |    |    |    |    |       |
| Agronomist                                | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     |
| Silviculturist                            | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 2     |
| Animal Ecolog.                            | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 2     |
| <b>PLANT PROTECTION</b>                   |    |    |    |    |    |    |    |    |       |
| Entomology                                | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 2     |
| Pathology/Quar.                           | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 2     |
| Nematology                                | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     |
| Produce Insp./                            | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     |
| Crop Storage                              | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 2     |
| <b>TECHNICAL SERVICES</b>                 |    |    |    |    |    |    |    |    |       |
| <b>SEED SERVICES</b>                      |    |    |    |    |    |    |    |    |       |
| Seed Technical                            | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 2     |
| Seed Pathology                            | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 2     |
| Gene Bank                                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 2  | 2     |
| <b>AGREDAT</b>                            |    |    |    |    |    |    |    |    |       |
| Biometrician                              | 0  | 0  | 0  | 0  | 2  | 0  | 0  | 0  | 2     |
| Economist                                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 2  | 2     |
| Systems Analyst                           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     |
| <b>LIBRARY</b>                            |    |    |    |    |    |    |    |    |       |
| Librarian                                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1     |
| Cataloguer                                | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     |
| <b>DAR HQ</b>                             |    |    |    |    |    |    |    |    |       |
| Station Administration                    | 0  | 0  | 0  | 2  | 1  | 0  | 0  | 2  | 5     |
| Total in Post                             | 0  | 0  | 0  | 4  | 4  | 2  | 15 | 67 | 92    |

As can be seen in Tables 6.1 and 6.2, the DAR's Career Structure is a pyramid, restrictive, inflexible and does not adequately cater for the large number of highly trained and experienced staff.

### 6.3.2 Proposed Improvements in DAR Career Structure and Incentives

The proposed career structure for professional staff is shown in Table 6.3 and Fig 6.2a. This structure has been broadened and posts upgraded to allow a research scientist to advance to the highest level possible in a discipline within a commodity group. For instance, any able scientist in any commodity group should be able to rise to the highest level of Controller of Agricultural Research Services P3 (Table 6.3).

This has consequently increased the current establishment from 111 to 144, thus allowing 33 additional posts (Table 6.4). The organograms showing this proposed establishment encompassing administrative, scientific and technical grades is shown in Figures 6.1. and 6.2a and 6.2b, respectively.

Table 6.3 DAR's Desired Scientific Staff Establishment by Commodity and Discipline

|   | CARTS<br>P2 | CARS/CARTS<br>P3 | DCARS<br>P4 | CAS<br>P5 | PAS<br>P7 | SAS<br>P8 | AS<br>PO | Total |
|---|-------------|------------------|-------------|-----------|-----------|-----------|----------|-------|
| <b>CEREALS</b>                            | 0           | 1                | 1           | 4         | 2         | 2         | 8        | 18    |
| Maize                                     |             |                  |             |           |           |           |          |       |
| Rice                                      |             |                  |             |           |           |           |          |       |
| Sorghum/Millet                            |             |                  |             |           |           |           |          |       |
| Wheat and Barley                          |             |                  |             |           |           |           |          |       |
| <b>HORTICULTURE</b>                       | 0           | 1                | 2           | 7         | 5         | 3         | 2        | 20    |
| Tropical Fruits                           |             |                  |             |           |           |           |          |       |
| Temperate Fruits                          |             |                  |             |           |           |           |          |       |
| Vegetables                                |             |                  |             |           |           |           |          |       |
| Root & Tubers                             |             |                  |             |           |           |           |          |       |
| Coffee                                    |             |                  |             |           |           |           |          |       |
| Tree Nuts                                 |             |                  |             |           |           |           |          |       |
| <b>LEGUMES, FIBRES<br/>AND OILSEEDS</b>   | 0           | 1                | 2           | 5         | 5         | 2         | 7        | 22    |
| Groundnuts                                |             |                  |             |           |           |           |          |       |
| Beans                                     |             |                  |             |           |           |           |          |       |
| Cotton                                    |             |                  |             |           |           |           |          |       |
| Oilseeds                                  |             |                  |             |           |           |           |          |       |
| Other Grain Legumes                       |             |                  |             |           |           |           |          |       |
| <b>LIVESTOCK</b>                          | 0           | 1                | 1           | 4         | 3         | 3         | 2        | 14    |
| Livestock                                 |             |                  |             |           |           |           |          |       |
| Pastures                                  |             |                  |             |           |           |           |          |       |
| <b>SOILS &amp; AGRIC.<br/>ENGINEERING</b> | 0           | 1                | 1           | 6         | 3         | 3         | 2        | 16    |
| Agroforestry                              |             |                  |             |           |           |           |          |       |
| Farm Machinery                            |             |                  |             |           |           |           |          |       |
| Irrigation & Drainage                     |             |                  |             |           |           |           |          |       |
| Soil Fertility                            |             |                  |             |           |           |           |          |       |
| Soil Microbiology                         |             |                  |             |           |           |           |          |       |
| Soil Survey                               |             |                  |             |           |           |           |          |       |
| <b>PLANT PROTECTION</b>                   | 0           | 1                | 1           | 1         | 1         | 2         | 4        | 10    |
| Entomology                                |             |                  |             |           |           |           |          |       |
| Pathology/quarantine                      |             |                  |             |           |           |           |          |       |
| Nematology                                |             |                  |             |           |           |           |          |       |
| Crop Storage/Inspection                   |             |                  |             |           |           |           |          |       |
| <b>TECHNICAL<br/>SERVICES</b>             | 0           | 1                | 1           | 5         | 4         | 4         | 4        | 19    |
| <b>AGREDAT</b>                            |             |                  |             |           |           |           |          |       |
| Seed Services                             |             |                  |             |           |           |           |          |       |
| Gene Bank                                 |             |                  |             |           |           |           |          |       |
| Library                                   |             |                  |             |           |           |           |          |       |
| Total Commodities                         | 0           | 7                | 9           | 32        | 23        | 22        | 32       | 125   |
| <b>HEADQUARTERS</b>                       | 1           | 3                | 1           | 1         | 1         | 1         | 1        | 9     |
| <b>STATION ADMIN.</b>                     | 0           | 3                | 1           | 3         | 0         | 3         | 0        | 10    |
| <b>TOTALS</b>                             | 1           | 13               | 11          | 36        | 24        | 26        | 33       | 144   |

CARTS = Chief of Agricultural Research and Technologies Services;  
 CARP = Controller of Agricultural Research Programmes;  
 CARS = Controller of Agricultural Research Services;  
 CATRS = Controller of Agricultural Technological Research Services;  
 DCARS = Deputy Controller of Agricultural Research Services;  
 DCARP = Deputy Controller of Agricultural Research Programmes  
 CAS = Chief Agricultural Scientist;  
 PAS = Principal Agricultural Scientist  
 SAS = Senior Agricultural Scientist;  
 AS = Agricultural Scientist.

CARTS

ARC

ARC ≥ CARP CARS

≥CATRS≥

NATIONAL NRCNATIONAL TECH.STATION  
 RESEARCH PLANTSERV. CORDINATORADMINISTR

COORDINATORS NRC PROTECTION (NRC) TRAINING

CEREALS GRAINLIVESTOCKSOILS & CROPS HORT LEGUMES AND AGRIC. PLANT  
 TECHNICAL LIAISON

Fig. 6.1; Desired DAR Organogram

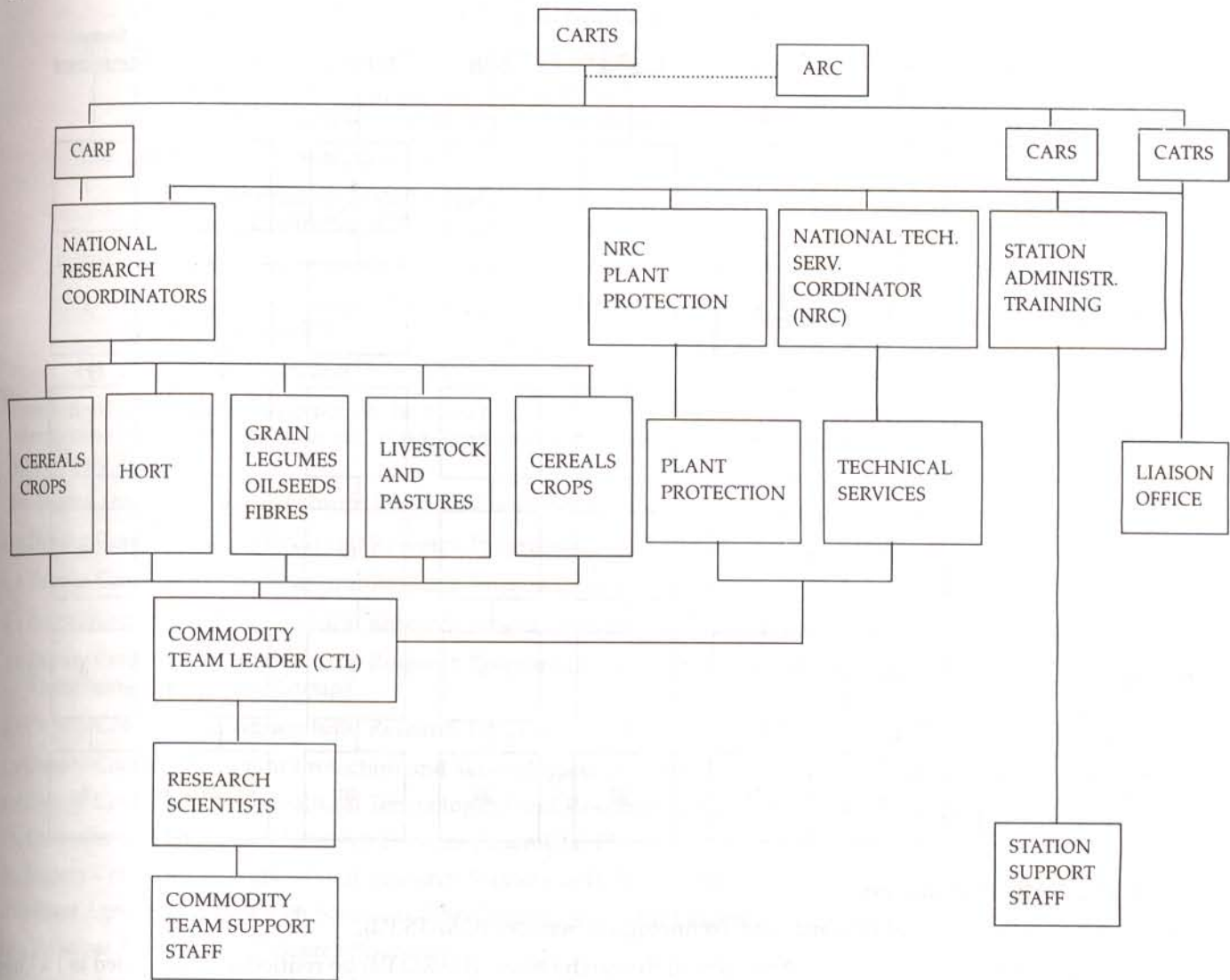


Fig. 6.2a: Desired Career Structure of Professional Staff by Grades in DAR

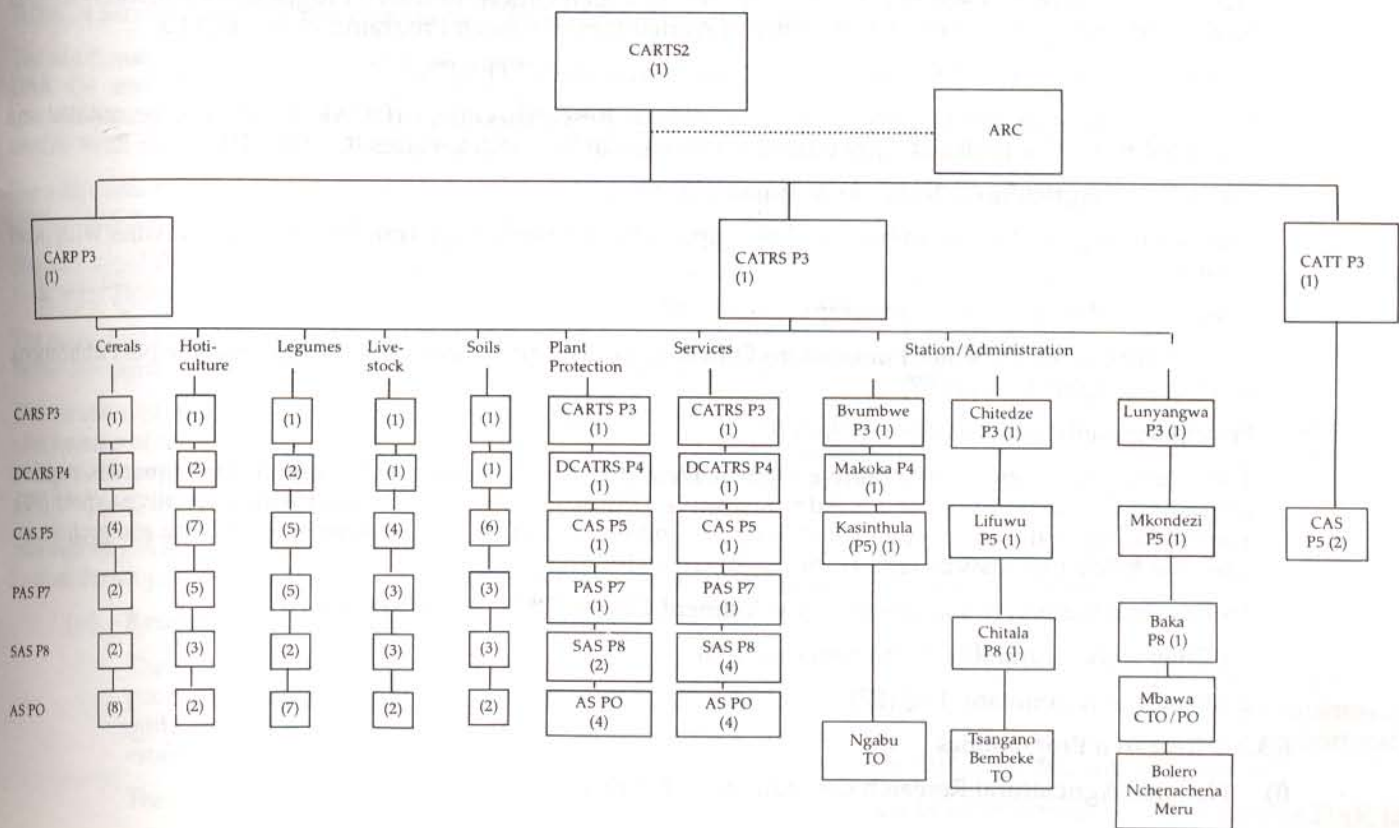


Fig. 6.2b: Desired Career Structure for Technicians by Gardes in DAR

|          | Cereals | Hort. | Legume | L/stock | Soils | P/Proct | Services | Station/<br>Management |
|----------|---------|-------|--------|---------|-------|---------|----------|------------------------|
| 8 = S8   | 1       | 1     | 1      | 1       | 1     | 1       | 1        | 1                      |
| 12 = CTO | 2       | 2     | 1      | 1       | 1     | 1       | 1        | 3                      |
| 26 = STO | 3       | 4     | 2      | 2       | 2     | 3       | 3        | 7                      |
| 53 = TO  | 9       | 11    | 5      | 4       | 6     | 10      | 8        | 0                      |
| 70 = STA | 11      | 11    | 8      | 8       | 9     | 5       | 5        | 0                      |
| 230 = TA | 46      | 44    | 33     | 32      | 35    | 20      | 20       | 0                      |

### 6.3.2.1 DAR Headquarters

- Chief of Agricultural Research and Technological Services (CARTS P2).

The current post of 1 x Chief Agricultural Research Officer (CARO P4) be retitled and upgraded to 1 x Chief of Agricultural Research and Technological Services, (CARTS, P2).

- Controller of Agricultural Research Programmes, (CARP) P3.

The current post of 1 x Deputy Chief Agricultural Research Officer, Research Programmes (DCARO - RP - P4) be re-titled and upgraded to 1 x Controller of Agricultural Research Programmes (CARP) P3.

- Controller of Agricultural Technological Research Services (CATRS P3).

The current post of 1 x Deputy Chief Agricultural Research Officer (DCARO-TSA -P5) be re-titled and upgraded to 1 x Controller of Agricultural Technological Research Services (CATRS) P3.

- Controller of Agricultural Technology Transfer (CATT) P3.

This is a new post. The incumbent will be responsible for technology transfer and liaison issues with other institutions.

- Principal Publications and Reprographic officer (P7).

The current post of 1 x Senior Publications Officer, (P8), be re-titled and upgraded to 1 x Principal Publications and Reprographic Officer (P7).

- Principal Administrative Officer (PAO) S7.

The establishment for administrative staff at Department of Agricultural Research Headquarters require upgrading the current post of 1 x Administrative Officer (AO) to 1 x Principal Administrative Officer (PAO) S7. The upgrading of the AO post will enable the incumbent discharge his duties with confidence and proficiency. Also, the following posts be created or upgraded as follows:

1 x Principal Human Resources and Development Officer (PHRO) S7 (Personnel).

1 x Chief Agricultural Research Economist (P5).

1 x Principal Accountant (PA) (P7).

### 6.3.2.2. Research Programmes

- (i) National Agricultural Research Co-ordinators (NARC).

The current positions of the 5 x National Agricultural Research Co-ordinators (NARC) be re-titled and upgraded to 5 x Deputy Controller of Agricultural Research Programmes, (P4).

(ii) National Technical Services Co-ordinator (NTSC).

The current position of the 1 x National Agricultural Technical Services Co-ordinator be re-titled and upgraded to 1 x Deputy Controller of Technological Research Services (DCARTS) P4 .

(iii) National Plant Protection Services Co-ordinator (NPPSC).

The current position of the 1 x National Plant Protection Services Co-ordinator be re-titled and upgraded to 1 x Deputy Controller of Plant Protection Services (P4).

(iv) Commodity Team Leaders (CTLs).

The current positions of 40 x Commodity Team Leaders be re-titled and upgraded to 40 x Chief Agricultural Scientists (CAS -P5).

(v) Agricultural Research Scientist (ARS).

There is need to upgrade and broaden the present career structure for scientists other than NARCS/NATC, and CTLs in order to cater for heads of section and productive scientists who excel in their scientific/technological fields, as shown in Table 6.3 and Fig 6.2

The desired structure for Agricultural Research Commodities, therefore, will be as follows (also see Table 6.3 and Fig 6.2).

1 x Deputy Controller of Agricultural Research Programmes (P4) (Cereals Commodity Group).

1 x Deputy Controller of Agricultural Research Programmes (P4) (Horticulture Commodity Group).

1 x Deputy Controller of Agricultural Research Programmes (P4) (Grain Legumes, Fibres & Oilseeds Commodity Group).

1 x Deputy Controller of Agricultural Research Programmes and Technological Services (P4) (Soils and Agricultural Engineering Commodity Group).

1 x Deputy Controller of Agricultural Research Programmes (P4) (Livestock and Pastures Commodity Group).

1 x Deputy Controller of Plant Protection and Technological Services (P4) (Plant Protection Commodity Group).

1 x Deputy Controller of Agricultural Technological and Research Services (P4) (Technical Services Group).

7 x Controller of Agricultural Research Services (Scientists) P3.

3 x Deputy Controller of Agricultural Research Services (P4) (Scientists).

40 x Chief Agricultural Research Scientists (P5) (Commodity Team Leaders)

30 x Principal Agricultural Research Scientists (P7)

25 x Senior Agricultural Scientists (P8)

31 x Agricultural Scientists (PO)

Additional PO (scientist) positions will be required for the proposed Commodity Teams in the Livestock, Horticulture and Technical Services Commodity Groups and also to man the proposed specialised laboratories.

The additional P8 (SAS) and P7 (PAS) positions will be filled by research scientists who prove to be competent. Currently, DAR has several experienced scientists who are fully-fledged researchers leading other scientists in their field of specialisation but have not received any form of recognition. The additional P8 and P7 positions will provide the incentive needed to all aspiring and productive scientists at PO level and potential employees.

The additional P5 (Chief Agricultural Scientist) posts requested will cater for heads of Section and some Commodity Team Leaders and for other scientists who excel in their disciplines.

The additional P4 (Deputy Controller of Agricultural Research Programmes/Technological Services) posts requested are to cater for Deputy Officers-In-Charge and other productive scientists who excel in their fields.

The additional P3 level posts (Controller of Agricultural Research Programmes/Technological Services) will be filled by Senior Scientists who are productive in their fields of specialisation.

The creation of these senior positions in various disciplines/Commodity Teams holds the key to the success and effectiveness of the DAR. It will provide an incentive to all scientists while ensuring that they continue their research work in their fields of specialisation. Also, it ensures that deserving scientists receive appropriate recognition to rise to the highest possible position while concentrating on their work.

The desired DAR's career structure positions for professional staff should be as shown in Table 6.4 and Fig. 6.2. Scientists to man the proposed commodities as in section 6.2.1 are also included in the desired career structure.

(vi) **Research Support Staff**

The rate of attrition of support staff in DAR is quite high also. This is fuelled by frustration stemming from a poor career structure. At the Technical Officer and Technical Assistant grades, the current career structure is quite restrictive considering the numbers of research support staff in DAR. The current research support staff establishment, posts filled and proposed positions, are detailed in Tables 6.1 and 6.4, respectively.

The fact that the establishment at the TO grade remains unfilled is an indication of the failure of DAR to

attract new staff members. In addition, the fact that established positions at CTO and STO levels are already filled, leaves no incentive for the aspiring officers presently at the TO grade. This emphasises the need, therefore, to create more CTO, STO and STA posts. Apart from attracting more staff to DAR, this will allow officers at the TO and TA grades to advance within the structure.

Of immediate concern at the moment are the unfilled STA posts in the DAR establishment. Immediate steps should be taken by DAR to ensure that those posts are filled by the deserving TAs already in post.

(vii) **Station Administration**

- The current post of head of station for Chitedze Agricultural Research Station 1 x Deputy Chief Agricultural Research Officer (P5) (DCARO) be re-titled and upgraded to 1 x Controller of Agricultural Research Services P3 (CARS).
- The current post of head of station for Bvumbwe Agricultural Research Station, 1 x Deputy Chief Agricultural Research Officer P5 be re-titled and upgraded to 1 x Controller of Agricultural Research Services P3 (CARS).
- The current post of head of station for Lunyangwa 1 x Deputy Chief Agricultural Research Officer (DCARO) P5 be re-titled and upgraded to 1 x Controller of Agricultural Research Services P3 (CARS).
- The current post of head of stations for Makoka 1 x DCARO be re-titled and upgraded to 1 x Deputy Controller of Agricultural Research Services (DCARS) P4.
- The current posts of heads of Experimental stations for Mkondezi, Lifuwu and Kasinthula Agricultural Research Stations be re-titled and upgraded to 3 x Principal Agricultural Scientists (PAS) P7.

The current posts of Heads of Sub-stations should be as follows: Baka (P8), Chitala (P8), Mbawa (CTO/PO), Bolero (TO), Ngabu (TO), Meru (TO), Ntchenachena (TO), Tsangano (TO) and Bembeke (TO).

3 x Senior Human Resources and Development Officer (for Chitedze, Bvumbwe and Lunyangwa Agricultural Research Stations).

3 x Senior Administrative Officer (PAO) (PS7) (for Chitedze, Bvumbwe and Lunyangwa Agricultural Research Stations).

3 x Senior Accountant S8 (for Chitedze, Bvumbwe and Lunyangwa Agricultural Research Stations).

1 x Human Resources and Development Officer (PO/CEO) for Makoka Agricultural Research Station.

1 x Accountant (PO/CEO) for Makoka Agricultural Research Station.

3 x Senior Assistant Human Resources and Development Officer (for Mkondezi, Lifuwu and Kasinthula Agricultural Research Stations).

3 x Senior Assistant Accountant (SEO) (for Kasinthula, Lifuwu and Mkondezi Agricultural Research Stations).

6.3.2.3 **Recruitment and Promotion**

Promotions should be based on the proposed DAR's desired career structure and according to performance (Table 6.3). Performance appraisal of DAR scientists and support staff, like in any other scientific organisation are vital for the maintenance of effective research programmes. Firstly, promotions motivate researchers towards attaining the development goals of DAR and the government of Malawi as a whole. Secondly, performance forms the basis for personnel actions such as wise job assignments, rational promotions, rewards, transfers and career development.

However, before a rational appraisal can be made on any researcher, it is a fundamental prerequisite on the part of the interviewing board to have a prior and thorough knowledge of the nature and requirements of the job and responsibilities of the concerned scientist, and/or the expected group's and/or individual's output in accordance with the scientist's job analysis and objectives of the team-work programme. To fulfil the above the government has approved the formation of a Professional Interviewing Board (PIB). DHRMD should ensure that PIB is in place immediately and functional. The board will be responsible for interviewing both professional and technical staff of TO grade and above.

6.3.2.3.1. **Entry Points**

- (a) A Professional Officer should be a holder of a Bachelor of Science degree.
- (b) If an officer is recruited with an M.Sc degree, the entry point should be at P7 grade with appropriate salary increments over the basic P7 salary depending on his/her training background and relevant experience.
- (c) An officer recruited with Ph.D. in the relevant scientific field should enter at the P5 grade with appropriate increments over the P5 basic salary.
- (d) Credit should be given to scientists who have published their research findings in scientific journals, magazines, newsletters, proceedings or whose research has had a big impact at national level.
- (e) Support staff (TOs or TAs) who have acquired a relevant degree/diploma should enter the scientific grades at the appropriate category.

### 6.3.2.3.2 Career Growth and Staff Motivation in DAR

In order to sustain high productivity in the DAR, it is a prerequisite that the government provide for career growth within the DAR in order to motivate and retain gifted research scientists. Particular attention will be placed on the provision of advancement opportunities within research (team), especially the scientists' own field of specialisation. The desired career structure is open to scientists within a commodity group to advance to the highest scientific level as shown in Fig. 6.2a.

### 6.3.2.3.3 Incentives

To augment the above career structure, the following incentives should continue:

- (i) Scientists may apply for sabbatical leave after working for at least 5 years and every five years thereafter.
- (ii) Leave of absence will be considered for an initial maximum period of 3 years and is renewable .
- (iii) Secondment is a prerogative of the employer and employee.
- (iv) The government should encourage and fund scientists to participate in workshops, symposia and seminars relevant to their field, Management should exercise neutrality in nominating people to attend workshops without bias or favour or management should allocate the same without bias or favour.
- (v) Scientists should be encouraged to take up relevant consultancies.
- (vi) DAR has set up a training committee to advise the CARTS on the departments' training needs and nominations.

A Professional Officer should be considered for further training to M.Sc. level during the first five years of service. On successful completion of the M.Sc. such an individual should be promoted to the P7 grade. After a further two years' service, such an individual should be considered for training to Ph.D. level if his/her performance and duties warrant it (see section on Evaluation of Performance).

## 6.4 EVALUATION OF PERSONNEL IN DAR

For scientists to be fairly evaluated the Department must ensure that there is adequate funding for their research projects. An effective evaluation process for research officers should be both continuous and interactive. The CATRS should issue clearly defined job descriptions to each scientist upon attaining a new post. The stipulated goals and objectives in the job description will enable evaluation to determine whether an officer has accomplished the stated goals and objectives. While the multidisciplinary team and/or group approach is good in some respects, in some cases it has "failed" to recognise special talent within a team or a group, where certain key individuals are "dominant".

First and foremost, while bearing in mind the job description of an officer, which sets out clearly the goals and objectives to be achieved within a specified period of time (e.g. 1 hr, 1 day, 1 year, 20, years: etc) an effective evaluation system should recognise an officer's technical ability; the amount of technology developed (that will potentially be taken up by the farming community); the services rendered to fellow researchers, departments and the farming community; creativity; managerial ability; contributions to the general public; and professional/technical contributions and achievements rendered locally, regionally and internationally.

The department should empower NRCs to monitor and evaluate scientists in their respective groups. The reports by NRCs should be submitted to controllers who in turn should monitor and evaluate NRC's. All this information should be made available to PIB at least one month before the promotion interviews.

### 6.4.1 Evaluation of Professional Officers in DAR

#### 6.4.1.1 Technical Ability

Technical ability should be measured through the following:

- (i) Research project reports setting out priorities and objectives:
  - preparation of budgets and reporting of research results for presentation at Project Meetings.
- (ii) Technical bulletins and reports:
  - all experiments conducted for 3 years should be written up as research bulletins and significant results extracted as papers to journals;
  - extension circulars;
  - journal publications (National/Regional/International);
  - symposia/seminar/workshop papers; and
  - abstracts and books.

#### 6.4.1.2 Technical Output

Technology developed and perfected for dissemination to, and adoption by, the farming community should be presented in the form of a recommendation package written up as an extension circular. Prior to the popularisation of the recommendations, the recommendation package should be approved by the ATCC. This also includes technologies developed for research workers such as implementation of



development of a new computer statistical analysis program. For the service groups and/or team technology output or popularisation, will be measured by the frequency, quantity of the services rendered to the farming community, research commodity teams and the general public. The services rendered directly to the public should be reflected in improved and increased crop/livestock production, food security, and improved standards of living for the rural community.

#### 6.4.1.3 Creativity

Creativity can be measured through a critical scrutiny of the quality of research projects which have innovations which greatly contribute to a new body of knowledge that significantly contributed to a quantum leap in agricultural productivity and the standards of living for the rural community. To get the best out of researchers, DAR needs to be more supportive of those scientists who are creative and have intuition.

#### 6.4.1.4 Managerial Ability

Research workers should also demonstrate the ability to manage fellow researchers, junior staff, and all the financial resources allocated to them. The ability to effectively manage human and financial resources should be recognized and rewarded.

#### 6.4.1.5 Special Contributions

A rewarding and effective evaluation system should also take cognizance of the following:-

- (i) Appointments to or participation in local, national, and international organisations, committees and societies, etc.
- (ii) Relevant consultancies and scientific awards (local, regional and international)
- (iii) Ability to solicit funding from other sources or organisations.

### 6.4.2 Evaluation of Technical Staff in DAR

#### 6.4.2.1 Technical Ability

This will be measured by the following:

- Comprehension of goals, objectives and research methodologies in the area of specialisation;
- ability to follow instructions in field/laboratory work with minimum supervision;
- reliability in data collection and presentation to responsible officers;
- ability to do preliminary analyses and writing of reports on activities of a section; and
- ability to act in the absence of a responsible officer.

#### 6.4.2.2 Creativity, Intuition and Special Talent

Ability to find and/or suggest sound alternative solutions to problems in conducting field/laboratory work and make on-the-spot decisions.

#### 6.4.2.3 Managerial Ability

Knowledge of basic stores procedures and ability to manage material resources such as farm inputs and ability to supervise subordinates.

## CHAPTER 7

### POLICY MAKERS, RESEARCHERS, EXTENSION WORKERS AND FARMERS LINKAGES

#### 7.1 INTRODUCTION

The establishment of effective channels of communication among policy makers, researchers, extension workers and users of the research technology (farmers, mostly) is necessary for the development, dissemination and adoption of appropriate technology. The national development policy defines research needs, objectives and the level of resources allocated to research and extension. However, some weaknesses have been observed in the linkages between partners in crops and livestock production. There is need, therefore, to strengthen the weak linkages between researchers, extension workers and policy makers to improve the work efficiency of the field staff. The desired improvements in agricultural production are enhanced if policy makers become committed to providing the financial and logistical support to both researchers and users of technology. Hence, effective linkages among the parties concerned become extremely important. This chapter reviews the present linkages and proposes improvements where necessary.

#### 7.2 PRESENT STATUS OF LINKAGES

##### 7.2.1 Policy Makers/Researchers Linkages

The key policy makers affecting the activities of DAR are: the Ministry of Finance, Economic Planning and Development (Treasury), ARC, MoALD and MoREA. The ARC approves research programmes and budgets in relation to the nationally-set research priorities and objectives. DAR submits these to the Treasury, through the MoALD, for funding and Treasury provides funds to MoALD. The MoALD allocates funds obtained from Treasury to DAR and various other departments.

Presently, Treasury and MoALD allocate insufficient funds to DAR which has hampered progress in research. One of the important reasons has been the failure of MoALD and DAR to publicise and/or quantify the necessary socio-economic benefits of research activities to influence policy makers to provide adequate funds for crops and livestock research. Consequently, DAR has spread its resources too thinly over a large number of projects without making the necessary impact. This has resulted in a vicious cycle where Treasury probably sees no justification for increased funding to DAR, and hence DAR continues to fail to make the necessary impact on agricultural production.

##### 7.2.2 Policy Makers/Extension Workers Linkages

Policy makers view extension services as a vehicle for technology transfer to farmers. The major constraint has been the failure of policy makers to provide adequate logistical support to the front-line field extension assistants who interact with farmers. The success of technology transfer and adoption by farmers depends on these field staff.

##### 7.2.3 Policy Makers/Farmers Linkages

The linkages between policy makers and farmers are top down with policy makers often making decisions for farmers; for example, setting prices without taking into account farmers' socio-economic circumstances. The result is that no matter how strong research and extension services may be, farmers fail to adopt the recommended practices because of poor marketing infrastructure. Enhanced linkages between policy makers and farmers can be achieved if farmers' opinions and circumstances are taken into account when making decisions about crops and livestock production (prices of inputs, pricing of produce, removal of subsidies).

##### 7.2.4 Researchers/Extension Workers Linkages

Effective linkages between research and extension are critical to the process of defining research goals and assessment criteria as well as the dissemination and adoption of new technologies by farmers. Producers' concerns should directly guide the research agenda and extension staff should be fully involved in the communication of research results to farmers.

Currently, a system of technology transfer exists but the flow of information to and from the farmer or researcher is inadequate. The main problem is not the absence of linkage activities but the inefficiency of the system and inadequate support for such activities. There should be a line budget item specifically for linkage activities in the budgets of CARO and CAETO. Also, the system should be improved to expedite decision-making and increase the flow of information and innovations in both directions.

Several linkage mechanisms exist in the Ministry of Agriculture and Livestock Development and these include:

1. Agriculture Handbook of Malawi
2. Guide to Agricultural Production
3. Newsletter (Za Achikumbi)
4. Extension circulars
5. Field days at research stations
6. Annual Research/Extension Workshops

development of a new computer statistical analysis program. For the service groups and/or technology output or popularisation, will be measured by the frequency, quantity of the services rendered to the farming community, research commodity teams and the general public. The services rendered directly to the public should be reflected in improved and increased crop/livestock production, security, and improved standards of living for the rural community.

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Currently, a system of technology transfer exists but the flow of information to and from the farmer or researcher is inadequate. The main problem is not the absence of linkage activities but the inefficiency of the system and inadequate support for such activities. There should be a line budget item specifically for linkages activities in the budgets of CARO and CAETO. Also, the system should be improved to expedite decision-making and increase the flow of information and innovations in both directions.

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2. Guide to Agricultural Production
3. Newsletter (Za Achikumbi)
4. Extension circulars
5. Field days at research stations
6. Annual Research/Extension Workshops

7. Extension/Research Review Meetings at ADDs
8. In-service training
9. Variety Release Committee
10. Agricultural Technology Clearing Committee (ATCC)
11. On-farm research trials
12. Production Development Committees
13. Annual research project meetings
14. MoALD's organisational structure
15. Description of Crop Varieties Grown in Malawi
16. Handbooks e.g. Coffee handbook, Cotton handbook, Pastures handbook, Guide to Vegetable Production, Species Production etc.
17. Research bulletins e.g. Beef fattening systems, Potential of 1/2 bred Malawi Zebu, X Friesian dairy cows.
18. Information linkages

Despite the existence of these linkages, the adoption of research technologies by the resource-poor farmers is poor. The research technologies have had limited impact on smallholders' productivity. In contrast, these same research technologies have been responsible for improvements in the productivity of estate farmers.

#### 7.2.5 Researchers/Farmers Linkages

Although most researchers have a farming background and normally take into account farmers' constraints and demands, research programmes still require "fine-tuning" to develop technologies for local specific socio-economic conditions of farmers. On-farm research activities provide a commendable linkage system for the two parties, particularly with regards to socio-economic and crop husbandry practices. Another occasion when researchers and farmers get together is during field days organised by the DAR. These linkages, between researchers and farmers, are extremely weak at the moment and more could be done to strengthen them.

#### 7.2.6 Extension Workers/Farmers Linkages

The extension service is closely linked with the farming community. The extension field assistants and their immediate supervisors (Development officers) frequently interact with farmers. The interactions between smallholders and extension workers are through individual meetings, farmers' clubs, group meetings and agricultural shows. The extension service, through the Agricultural Communications Branch, also reaches farmers through publications, radio programmes, mobile film shows, posters, slides, puppet shows, field days and farmers' training sessions.

### 7.3 PROPOSALS FOR IMPROVING LINKAGES AND TECHNOLOGY TRANSFER

Research is considered successful only if the technology it produces can be translated by the extension service into messages which farmers are willing and able to adopt. This largely depends, among other factors, upon the effectiveness of interactions between research and extension. Such interactions increase the relevance of research output by letting scientists know farmers' problems that require research attention and also improve research efficiency in priority setting, technology development and identification of non-technical constraints which affect the adoption of new technologies. Despite their importance, these linkages or interactions are generally weak. There is need to establish and maintain mutually-supportive mechanisms to promote effective two-way communication. Different approaches are proposed and described below.

#### 7.3.1 Policy Makers/Researchers Linkages

Linkages between policy makers and researchers can be improved if DAR can supply information to policy makers on establishing priorities among competing development programmes. AGREDAT of DAR should be charged with the responsibility of preparing socio-economic data in a format that can be used by policy makers. This will show policy makers the benefits of increased crop and livestock production from its research activities. The activities of this commodity team would complement those of the Planning Division of the MoALD. In addition, DAR's annual reports of completed and planned research programmes, including their estimated costs, should be made available to policy makers in a timely manner. The Treasury, on the other hand, should provide adequate resources to sustain the major activities of DAR in the long term.

#### 7.3.2 Research/Extension Linkages

Linkages between research and extension should function as a powerful mechanism to promote agricultural production. To achieve this, there is need to strengthen and maintain mutually-supportive mechanisms to promote effective two-way communication as detailed below:

### 7.3.2.1 **Agricultural Technology Clearing Committee**

ATCC's function is to evaluate the suitability and appropriateness of new technologies before they are passed on to the farming community. Membership of this committee includes a few permanent members from DAR, DAET and DAHI whilst other members are co-opted as need arises. The chairman of the committee is the CAS (Technical). The committee meets irregularly. The committee and the process by which innovations are released could be streamlined. This will encourage regular documentation of research recommendations and the agreed-upon changes to ecological zone-specific recommendations. The committee should meet at least three times in a year.

### 7.3.2.2 **On-Farm Research**

The importance of direct farmer-researcher contact cannot be over-emphasised. There is a need to directly involve the farmer in problem identification, planning and execution of on-farm trials. Researchers should be exposed to participatory and extension research methods (PERM) to improve their communication skills. All commodity research teams should be responsible for the testing of new technologies in farmer's fields prior to the release of such technology.

### 7.3.2.3 **Workshops**

A national research-extension workshop should be organised at least once annually. Participation in such workshops would be at a high level and small enough to allow for consensus on overall strategies, priorities, and ameliorative measures. The agenda of the meeting should be agreed upon by the CARO, CAETO, CVO and NRCs Programme Managers should address problems occurring in research-extension linkages, agree on aspects requiring improvements and propose suitable measures for their respective ADDs. In all research extension workshops, active participation of DAR staff should be encouraged.

### 7.3.2.4 **Planning Meetings**

Research-extension planning meetings offer an important form of linkage between the two parties. Such meetings should be held annually at ADD level to review an ADD's activities in agricultural production and to highlight the major constraints. The participants in such meetings should include NRCs, CTLs and ADD staff. This would enhance collaboration between the parties working on similar problems and promote a two-way dialogue.

A more formal linkage between research and extension is during annual research project meetings. Extension workers' presentations should preface those from DAR researchers in order to properly scrutinise DAR's programmes if they address problems identified by extension workers in the field. Also, during these meetings, only completed and proposals of new research programmes should be deliberated upon. In this way, the duration of such meetings will be far shorter than is the case now. In addition, there will be significant savings in costs for holding such meetings.

### 7.3.2.5 **Field Days**

Field days are also an important formal interaction among researchers, extension workers and farmers. DAR conducts several field days annually to which the farming community, donor agencies, representatives from Agro-industries, DAET, DAHI and NGOs are invited. However, there is need for better organisation of these field days to cater for all interest groups. For example, farmers should be in their own special groups and appropriate local languages should be used alongside English. Tentative dates of such events could be publicised well in advance to avoid a clash in programmes of would-be participants, and there should be a line budget item for field days' costs.

### 7.3.2.6 **Liaison Officer**

DAR's current liaison services are highly inadequate to facilitate effective linkages between researchers, extension workers, NGOs, other institutions involved in crops and livestock research, and farmers. The liaison officer should be the link between DAR and DAET, DAHI, and other institutions such as the University, ARET, TREF, SUCOMA and NGOs. A clear job description for the research liaison officer should be developed. A budget line item for his/her activities should be created in CARO's budget.

### 7.3.2.7 **Agricultural Booklets**

The agricultural booklets for transfer of technology (i.e. Agriculture in Malawi, Guide to Agricultural Production (GAP), extension circulars and farmers' newsletters (e.g., Za Achikumbi) should be revised and updated as need arises so as to include current production technologies for crops and livestock, and also ecological zone-specific recommendations. There is need to publish most of these booklets, such as the GAP, in local languages besides the English language in order to reach out a wider audience of farmers.

### 7.3.2.8 **Informal Linkages**

There should be planned joint visits by researchers and extension workers to each ADD once in a month during the growing season to see, on-the-spot, how farmers implement the

recommended technologies, discuss methods of increasing feed back. Also, such visits will enable both parties to discuss with farmers what problems they may be experiencing with the recommended technologies. These joint visits should be funded from the linkages item in the CARO's and CAETO's budgets.

#### 7.3.2.9 **Research and University Linkages**

The present linkages between DAR and the University of Malawi are inadequate, and yet the Department is a major employer of graduates and diplomates from this institution. There is therefore, much need and scope for formally establishing closer collaboration between the two institutions so that DAR scientists can assist in teaching courses for which the University may be deficient in staff, or to make available their research facilities for teaching purposes. In this way, students on advanced degree courses could do research with DAR scientists, gain on-the-job experience and develop an appreciation of what they are likely to do after graduation.

#### 7.3.2.10 **Non-Governmental Organisations and Agro-Industries**

NGOs, agro-industry, farmers' groups and associations should be encouraged by the government to interact with DAR, DAET, DAHI and farmers. These organisations should participate in the planning and implementation of research programmes and in technology transfer.

### 7.4 **AGRICULTURAL PRICING POLICY**

Agricultural pricing policy has major implications on agricultural production and the growth of other sectors of the economy. Pricing policy decisions for both farm inputs and outputs directly affect rural incomes. To promote increased agricultural production, it is necessary for farmers to have favourable farm inputs cost/producer price relationship. Such a favourable relationship would enable farmers to adopt most of the technologies generated by research thereby resulting in increased agricultural production and rural incomes.

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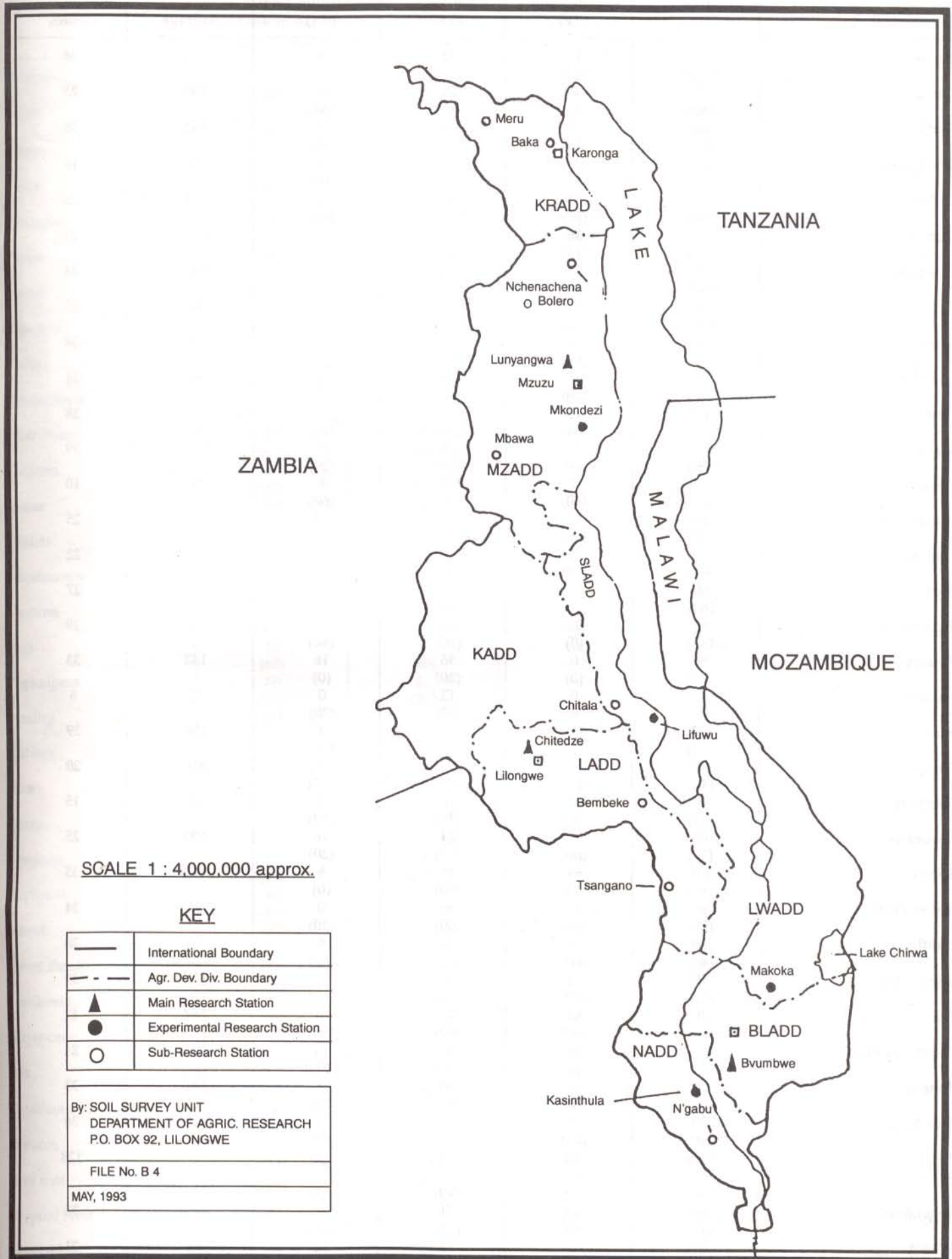
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APPENDIX 1.: MAP OF MALAWI

AGRICULTURAL RESEARCH STATIONS



SCALE 1 : 4,000,000 approx.

KEY

|  |                               |
|--|-------------------------------|
|  | International Boundary        |
|  | Agr. Dev. Div. Boundary       |
|  | Main Research Station         |
|  | Experimental Research Station |
|  | Sub-Research Station          |

By: SOIL SURVEY UNIT  
DEPARTMENT OF AGRIC. RESEARCH  
P.O. BOX 92, LILONGWE

FILE No. B 4

MAY, 1993

## APPENDIX II. DETERMINATION OF PRIORITIES ACCORDING TO NATIONAL GOALS

| Commodity       | Food Value<br>(1) | Export Value<br>(0.8) | Cash Value<br>(0.6) | Import<br>Substitution Total<br>(0.4) | Average     | Scores |
|-----------------|-------------------|-----------------------|---------------------|---------------------------------------|-------------|--------|
| Beans           | 80<br>(60) (0)    | 16<br>(40)            | 48<br>(40)          | 8                                     | 152         | 38     |
| Cassava         | 60<br>(80)        | 0<br>(0)              | 24<br>(80)          | 16<br>(60)                            | 100         | 25     |
| Cattle          | 80<br>(20)        | 0<br>(20)             | 48<br>(60)          | 24<br>(0)                             | 152         | 38     |
| Chickpeas       | 20<br>(20)        | 16<br>(80)            | 36<br>(60)          | 0<br>(60)                             | 72          | 18     |
| Coffee          | 20<br>(20)        | 64<br>(20)            | 36<br>(100)         | 24<br>(60)                            | 144         | 36     |
| Cotton          | 20<br>(40)        | 16<br>(40)            | 60<br>(40)          | 24<br>(0)                             | 120         | 30     |
| Cowpeas         | 40<br>(60)        | 32<br>(0)             | 24<br>(40)          | 0<br>(20)                             | 96          | 24     |
| Goats           | 60<br>(60)        | 0<br>(60)             | 24<br>(60)          | 8<br>(20)                             | 92          | 23     |
| Groundnuts      | 60<br>(0)         | 48<br>(60)            | 36<br>(60)          | 8<br>(0)                              | 152         | 38     |
| Guar beans      | 0<br>(60)         | 48<br>(20)            | 36<br>(60)          | 0<br>(0)                              | 84          | 21     |
| Potato          | 60                | 16<br>(100)           | 36<br>(20)          | 0<br>(40)                             | 112<br>(40) | 28     |
| Maize           | 100<br>(20)       | 16<br>(0)             | 24<br>(20)          | 16<br>(20)                            | 156         | 39     |
| Millet          | 20<br>(20)        | 0<br>(40)             | 12<br>(60)          | 8<br>(60)                             | 40          | 10     |
| Mushrooms       | 20<br>(60)        | 32<br>(20)            | 24<br>(20)          | 24<br>(0)                             | 100         | 25     |
| Pastures        | 60<br>(60)        | 16<br>(20)            | 12<br>(40)          | 0<br>(20)                             | 88          | 22     |
| Pigs            | 60<br>(60)        | 16<br>(40)            | 24<br>(40)          | 8<br>(0)                              | 108         | 27     |
| Pigeonpeas      | 60<br>(80)        | 32<br>(0)             | 24<br>(60)          | 0<br>(40)                             | 116         | 29     |
| Poultry         | 80<br>(20)        | 0<br>(0)              | 36<br>(20)          | 16<br>(0)                             | 132         | 33     |
| Rabbits         | 20<br>(80)        | 0<br>(40)             | 12<br>(60)          | 0<br>(20)                             | 32          | 8      |
| Rice            | 80<br>(40)        | 32<br>(0)             | 36<br>(40)          | 8<br>(40)                             | 156         | 39     |
| Sheep           | 40<br>(40)        | 0<br>(0)              | 24<br>(20)          | 16<br>(20)                            | 80          | 20     |
| Sorghum         | 40<br>(60)        | 0<br>(0)              | 12<br>(40)          | 8<br>(40)                             | 60          | 15     |
| Soybeans        | 60<br>(20)        | 0<br>(80)             | 24<br>(80)          | 16<br>(20)                            | 100         | 25     |
| Spices          | 20<br>(60)        | 64<br>(0)             | 48<br>(60)          | 8<br>(0)                              | 140         | 35     |
| Sweet Potato    | 60<br>(20)        | 0<br>(20)             | 36<br>(60)          | 0<br>(20)                             | 96          | 24     |
| Sunflower       | 20<br>(40)        | 16<br>(80)            | 36<br>(60)          | 8<br>(40)                             | 80          | 20     |
| Sugar-cane      | 40<br>(20)        | 64<br>(80)            | 36<br>(80)          | 16<br>(80)                            | 156         | 39     |
| Tea             | 20<br>(20)        | 64<br>(20)            | 48<br>(60)          | 32<br>(60)                            | 164         | 41     |
| Deciduous Fruit | 20<br>(           | 16<br>(0)             | 36<br>(80)          | 24<br>(100)                           | 96<br>(20)  | 24     |
| Tobacco         | 0<br>(20)         | 64<br>(80)            | 60<br>(60)          | 8<br>(0)                              | 132         | 33     |
| Tree Nuts       | 20<br>(60)        | 64<br>(40)            | 36<br>(60)          | 0<br>(0)                              | 120         | 30     |
| Tropical<br>32  | Frui<br>(80)      | 60<br>(60)            | 32<br>(40)          | 36<br>(0)                             | 0           | 128    |
| Vegetables      | 80<br>(40)        | 48<br>(0)             | 24<br>(20)          | 0<br>(80)                             | 152         | 38     |
| Wheat           | 40<br>(60)        | 0<br>(40)             | 12<br>(60)          | 32<br>(40)                            | 84          | 21     |
| Citrus          | 60                | 32                    | 36                  | 16                                    | 144         | 36     |

| Commodity       | Lack of on Shelf Techn. | Yield Differential | Demand of Technology | Total Score | Average Score |
|-----------------|-------------------------|--------------------|----------------------|-------------|---------------|
|                 | (1)                     | (0.8)              | (0.6)                |             |               |
| Beans           | (40)                    | (60)               | (60)                 |             |               |
|                 | 40                      | 48                 | 36                   | 124         | 41            |
| Cassava         | (60)                    | (60)               | (60)                 |             |               |
|                 | 60                      | 48                 | 36                   | 144         | 48            |
| Cattle          | (60)                    | (80)               | (60)                 |             |               |
|                 | 60                      | 64                 | 36                   | 160         | 53            |
| Chickpeas       | (60)                    | (60)               | (20)                 |             |               |
|                 | 60                      | 48                 | 12                   | 120         | 40            |
| Coffee          | (80)                    | (60)               | (80)                 |             |               |
|                 | 80                      | 48                 | 48                   | 176         | 59            |
| Cotton          | (80)                    | (80)               | (60)                 |             |               |
|                 | 80                      | 64                 | 36                   | 180         | 60            |
| Cowpeas         | (80)                    | (60)               | (40)                 |             |               |
|                 | 80                      | 48                 | 24                   | 152         | 51            |
| Goats           | (80)                    | (40)               | (40)                 |             |               |
|                 | 80                      | 32                 | 24                   | 136         | 45            |
| Groundnuts      | (40)                    | (80)               | (60)                 |             |               |
|                 | 40                      | 64                 | 36                   | 140         | 47            |
| Guar Beans      | (40)                    | (60)               | (40)                 |             |               |
|                 | 40                      | 48                 | 24                   | 112         | 37            |
| Potatoes        | (60)                    | (80)               | (60)                 |             |               |
|                 | 60                      | 64                 | 36                   | 160         | 53            |
| Maize           | (40)                    | (60)               | (20)                 |             |               |
|                 | 40                      | 48                 | 12                   | 100         | 34            |
| Millet          | (20)                    | (80)               | (40)                 |             |               |
|                 | 20                      | 64                 | 24                   | 108         | 36            |
| Mushrooms       | (60)                    | (60)               | (80)                 |             |               |
|                 | 60                      | 48                 | 48                   | 156         | 52            |
| Pastures        | (60)                    | (20)               | (40)                 |             |               |
|                 | 60                      | 16                 | 24                   | 100         | 33            |
| Pigs            | (40)                    | (60)               | (60)                 |             |               |
|                 | 40                      | 48                 | 36                   | 124         | 41            |
| Pigeonpeas      | (60)                    | (80)               | (60)                 |             |               |
|                 | 60                      | 64                 | 36                   | 160         | 53            |
| Poultry         | (60)                    | (80)               | (80)                 |             |               |
|                 | 60                      | 64                 | 48                   | 172         | 57            |
| Rabbits         | (60)                    | (20)               | (20)                 |             |               |
|                 | 60                      | 16                 | 12                   | 88          | 29            |
| Rice            | (40)                    | (80)               | (60)                 |             |               |
|                 | 40                      | 64                 | 36                   | 140         | 47            |
| Sheep           | (60)                    | (60)               | (40)                 |             |               |
|                 | 60                      | 48                 | 24                   | 132         | 44            |
| Sorghum         | (60)                    | (80)               | (40)                 |             |               |
|                 | 60                      | 64                 | 24                   | 148         | 49            |
| Soybeans        | (40)                    | (80)               | (60)                 |             |               |
|                 | 40                      | 64                 | 36                   | 140         | 47            |
| Spices          | (60)                    | (60)               | (40)                 |             |               |
|                 | 60                      | 48                 | 24                   | 132         | 44            |
| Sweet Potato    | (40)                    | (80)               | (40)                 |             |               |
|                 | 40                      | 64                 | 24                   | 128         | 43            |
| Sunflower       | (80)                    | (80)               | (40)                 |             |               |
|                 | 80                      | 64                 | 24                   | 168         | 56            |
| Sugar-cane      | (20)                    | (40)               | (60)                 |             |               |
|                 | 20                      | 32                 | 36                   | 88          | 29            |
| Tea             | (20)                    | (20)               | (60)                 |             |               |
|                 | 20                      | 16                 | 36                   | 72          | 24            |
| Deciduous Fruit | (60)                    | (80)               | (60)                 |             |               |
|                 | 60                      | 64                 | 36                   | 160         | 53            |
| Tobacco         | (20)                    | (60)               | (80)                 |             |               |
|                 | 20                      | 48                 | 48                   | 116         | 39            |
| Tree nuts       | (80)                    | (60)               | (80)                 |             |               |
|                 | 80                      | 48                 | 48                   | 176         | 59            |
| Tropical Fruit  | (80)                    | (80)               | (80)                 |             |               |
|                 | 80                      | 64                 | 48                   | 192         | 64            |
| Vegetables      | (60)                    | (60)               | (60)                 |             |               |
|                 | 60                      | 48                 | 36                   | 144         | 48            |
| Wheat           | (60)                    | (80)               | (40)                 |             |               |
|                 | 60                      | 64                 | 24                   | 148         | 49            |
| Citrus          | (80)                    | (60)               | (80)                 |             |               |
|                 | 80                      | 48                 | 48                   | 176         | 59            |

## APPENDIX IV. Determination of the Final Score for Commodity Research Priority

| Commodity       | Total Score National Goals | Total Score of Res. & Technical Factors | Final Score |
|-----------------|----------------------------|---|-------------|
| Beans           | 38                         | 41                                      | 79          |
| Cassava         | 25                         | 48                                      | 73          |
| Cattle          | 38                         | 53                                      | 91          |
| Chickpeas       | 18                         | 40                                      | 58          |
| Coffee          | 36                         | 59                                      | 95          |
| Cotton          | 30                         | 60                                      | 90          |
| Cowpeas         | 24                         | 51                                      | 75          |
| Goats           | 23                         | 45                                      | 68          |
| Groundnuts      | 38                         | 47                                      | 85          |
| Guar beans      | 21                         | 37                                      | 58          |
| Potato          | 28                         | 53                                      | 81          |
| Maize           | 39                         | 34                                      | 73          |
| Millet          | 10                         | 36                                      | 46          |
| Mushrooms       | 25                         | 52                                      | 77          |
| Pastures        | 22                         | 33                                      | 55          |
| Pigs            | 27                         | 41                                      | 68          |
| Pigeonpeas      | 29                         | 53                                      | 82          |
| Poultry         | 33                         | 57                                      | 90          |
| Rabbits         | 8                          | 29                                      | 37          |
| Rice            | 39                         | 47                                      | 86          |
| Sheep           | 20                         | 44                                      | 64          |
| Sorghum         | 15                         | 49                                      | 64          |
| Soybeans        | 25                         | 47                                      | 72          |
| Spices          | 35                         | 44                                      | 79          |
| Sweet Potato    | 24                         | 43                                      | 67          |
| Sunflower       | 20                         | 56                                      | 76          |
| Sugar cane      | 39                         | 29                                      | 68          |
| Tea             | 41                         | 24                                      | 65          |
| Deciduous Fruit | 24                         | 53                                      | 77          |
| Tobacco         | 33                         | 39                                      | 72          |
| Tree Nuts       | 30                         | 59                                      | 89          |
| Tropical Fruit  | 32                         | 64                                      | 96          |
| Vegetables      | 38                         | 48                                      | 86          |
| Wheat           | 21                         | 49                                      | 70          |
| Citrus          | 36                         | 59                                      | 95          |

## APPENDIX V. Priority List for Crops and Livestock in Malawi

| Commodity       | Overall Priority* | Priority To National According Goals** | Priority According To Research and Technical Factors*** |
|-----------------|-------------------|--|---|
| Tropical Fruit  | 1                 | 7                                      | 1   |
| Coffee          | 21                | 4                                      | 3   |
| Citrus          | 2                 | 4                                      | 3   |
| Cattle          | 3                 | 3                                      | 6   |
| Cotton          | 4                 | 8                                      | 2   |
| Poultry         | 4                 | 6                                      | 4   |
| Tree nuts       | 5                 | 8                                      | 3   |
| Rice            | 6                 | 2                                      | 11  |
| Vegetables      | 6                 | 3                                      | 10  |
| Groundnuts      | 7                 | 3                                      | 11  |
| Pigeon peas     | 8                 | 9                                      | 6   |
| Beans           | 10                | 3                                      | 15  |
| Spices          | 10                | 5                                      | 13  |
| Mushroom        | 11                | 12                                     | 7   |
| Deciduous fruit | 11                | 13                                     | 6   |
| Sun flower      | 12                | 17                                     | 5   |
| Cowpeas         | 13                | 13                                     | 8   |
| Potato          | 9                 | 10                                     | 6   |
| Maize           | 14                | 2                                      | 20  |
| Cassava         | 14                | 12                                     | 10  |
| Soybeans        | 15                | 12                                     | 11  |
| Wheat           | 16                | 16                                     | 9   |
| Pigs            | 17                | 11                                     | 15  |
| Sweet potato    | 18                | 13                                     | 14  |
| Millet          | 23                | 20                                     | 19  |
| Chickpeas       | 24                | 18                                     | 16  |
| Guarbeans       | 21                | 16                                     | 18  |
| Sheep           | 21                | 17                                     | 13  |
| Sorghum         | 20                | 19                                     | 9   |
| Pasture         | 22                | 15                                     | 21  |
| Goats           | 17                | 14                                     | 12  |
| Rabbit          | 24                | 21                                     | 22  |

\* No.19 is Tea, \*\* No.1 is Tea, \*\*\* No.17 is Tobacco which are not under DAR,s mandate.

## APPENDIX VI. Ranking of Commodity Group According to Checklist method as done by Scientists

| Commodity                        | Ranking by Scientists Total |              | Ranking | Total |      |
|----------------------------------|-----------------------------|--------------|---------|-------|------|
|                                  | Final Weighting             | % Allocation |         |       |      |
| Cereals                          | 2, 1, 1, 2, 1, 1, 1         | 9            | 1       | 100   | 20.4 |
| Horticulture                     | 1, 4, 2, 3, 4, 3, 2         | 19           | 2       | 90    | 18.4 |
| Livestock & Pastures             | 4, 3, 3, 4, 3, 5, 4         | 26           | 3       | 80    | 16.4 |
| Grain Legumes & Oilseeds         | 3, 2, 4, 5, 6, 2, 5         | 27           | 4       | 70    | 14.3 |
| Soils & Agricultural Engineering | 6, 5, 6, 1, 5, 4, 3         | 30           | 5       | 60    | 12.1 |
| Services                         | 5, 6, 5, 6, 2, 6, 6         | 36           | 6       | 50    | 10.2 |
| Adaptive Research                | 7, 7, 7, 7, 7, 7, 7         | 49           | 7       | 40    | 8.2  |

## APPENDIX VII. Commodity Priorities According to Importance at ADD Level

## BLANTYRE ADD

| Priority I   | Priority II   | Priority III | Priority IV |
|--------------|---------------|--------------|-------------|
| Maize        | Tobacco       | Millet       | Guarbeans   |
| Pigeonpeas   | Wheat         | Coffee       | Yams        |
| Cowpeas      | Sugarcane     | Cashew nuts  | Mushroom    |
| Beans        | Leucena       | Silverleaf   | Guinea Pigs |
| Tea          | Avocado Pears | Chillie      |             |
| Cotton       | Macadamia     | Chickpeas    |             |
| Nappier      | Cassava       | Potato       |             |
| Tomato       | Sorghum       | Sesame       |             |
| Bananas      | Rice          | Groundbeans  |             |
| Chickens     | Sweet potato  | Ducks        |             |
| Dairy Cattle | Soyabeans     | Turkeys      |             |
| Goats        | Rhodes grass  | Rabbits      |             |
|              | Sunflower     | Doves        |             |
|              | Beef Cattle   |              |             |
|              | Pigs          |              |             |
|              | Sheep         |              |             |

## KARONGA ADD

| Priority I   | Priority II     | Priority III | Priority IV |
|--------------|-----------------|--------------|-------------|
| Maize        | Beans           | Chillie      |             |
| Cassava      | Groundnuts      | Sorghum      |             |
| Rice         | Vegetables      | Pigeonpeas   |             |
| Cotton       | Fruits          | Cowpeas      |             |
| Tobacco      | Millet          | Peas         |             |
| Pasture      | Banana          | Sunflower    |             |
| Cattle       | Cashew Nuts     | Okra         |             |
| Chickens     | Potato          | Sugarcane    |             |
| Sweet potato | Groundbeans     | Groundbeans  |             |
|              | Citrus          | Ginger       |             |
|              | Mangoes Tumeric | Tumeric      |             |
|              | Goats           | Guava        |             |
|              | Sheep           | Avocado      |             |
|              | Pigs            | Rabbits      |             |
|              |                 | Ducks        |             |
|              |                 | Pigeons      |             |
|              |                 | Guinea Fowls |             |
|              |                 | Turkeys      |             |

## KASUNGU ADD

| Priority I       | Priority II | Priority III  | Priority IV |
|------------------|-------------|---------------|-------------|
| Maize            | Beans       | Finger millet |             |
| Tobacco          | Soyabeans   | Groundbeans   |             |
| Groundnuts       | Sunflower   | Carrot        |             |
| Cassava          | Cowpeas     | Guava         |             |
| Sweet potato     | Wheat       | Pawpaw        |             |
| Cotton           | Potato      | Lemon         |             |
| Brassicas        | Sugarcane   | Sheep         |             |
| Tomato           | Pumpkin     | Donkeys       |             |
| Pasture          | Macadamia   |               |             |
| Local Vegetables | Coffee      |               |             |
| Cattle           | Onion       |               |             |
| Goats            | Mango       |               |             |
| Chickens         | Banana      |               |             |
|                  | Orange      |               |             |
|                  | Tangerine   |               |             |
|                  | Rabbits     |               |             |
|                  | Pigs        |               |             |
|                  | Bee-keeping |               |             |

## SALIMA ADD

| Priority I   | Priority II   | Priority III  | Priority IV                 |
|--|---|---|-----------------------------|
| Maize<br>Cassava<br>Cotton<br>Tobacco<br>Goats<br>Chickens | Pastures<br>Groundnuts<br>Sweet potato<br>Cowpeas<br>Chillie<br>Soyabeans<br>Beans<br>Cabbage<br>Rice<br>Mpilu<br>Onion<br>Okra<br>Pumpkins<br>Bananas<br>Mangoes<br>Beef Cattle<br>Sheep<br>Pigs | Sorghum<br>Pigeonpeas<br>Finger millet<br>Sunflower<br>Tomato<br>Cashew nuts<br>Gram<br>Groundbeans<br>Sesame<br>Chomolia<br>Carrots<br>Eggplants<br>Spices<br>Amaranthus<br>Local Rape<br>Citrus<br>Pawpaw<br>Rabbits<br>Donkeys<br>Turkeys<br>Pigeons<br>Dairy cattle | Guava<br>Pineapple<br>Ducks |

## Appendix VIII. Commodity Research Needs at ADD Level

## BLANTYRE ADD

| Priority I  | Priority II   | Priority III   | Priority IV |
|---|---|--|-------------|
| Bananas<br>Citrus<br>Pineapples<br>Goats<br>Turkey<br>Sheep<br>Dairy cattle | Wheat<br>Sugarcane<br>Millet<br>Potato<br>Indigenuos/<br>Vegetables<br>Cassava<br>Sweetpotato<br>Chicken<br>Beef cattle | Chillie<br>Maize<br>Cotton<br>Pulses<br>Sunflower<br>Pigs<br>Turkeys |             |

## KARONGA ADD

| Priority I  | Priority II                           | Priority III                          | Priority IV |
|---|---------------------------------------|---------------------------------------|-------------|
| Rice<br>Maize<br>Groundnuts<br>Vegetables<br>Cattle<br>Chickens | Banana<br>Cassava<br>Beans<br>Pasture | Cashew nuts<br>Sweet potato<br>Potato |             |

## KASUNGU ADD

| Priority I                       | Priority II   | Priority III                                   | Priority IV  |
|----------------------------------|---|--|--|
| Maize<br>Sweet potato<br>Cassava | Vegetables<br>Finger millet<br>Cotton<br>Beekeeping | Tropical fruits<br>Temperate fruits<br>Rabbits | Tobacco<br>Cattle<br>Poultry<br>Sheep<br>Pigs<br>Goats |

## LILONGWE ADD

| Priority I   | Priority II   | Priority III     | Priority IV |
|--|---|------------------|-------------|
| Sweetpotato<br>Tropical fruits<br>Indigeous veg.<br>Beans<br>Potato<br>Pastures<br>Temperate fruits<br>Maize<br>Cassava<br>Sunflower<br>Chicken<br>Beef<br>Goats<br>Pigs<br>Dairy cattle | Groundnuts<br>Pigeonpeas<br>Wheat<br>Millet<br>Cowpeas<br>Soyabeans<br>Treenuts<br>Spices<br>Tobacco<br>Donkeys<br>Work oxen<br>Eggs<br>Rabbits | Coffee<br>Cotton |             |



## LILONGWE ADD

| Priority I       | Priority II     | Priority III     | Priority IV |
|------------------|-----------------|------------------|-------------|
| Sweet potato     | Groundnuts      | Cassava          | Wheat       |
| Beans            | Indigenous Veg. | Pastures         | Spices      |
| Maize            | Tropical Fruits | Temperate Fruits | Cotton      |
| Potato           | Spices          | Soyabeans        | Millet      |
| Tropical Fruits  | Coffee          | Tree Nuts        | Coffee      |
| Sweet potato     | Cowpeas         | Pigeonpeas       | Sunflower   |
| Indigenous Veg.  | Beef Cattle     | Cowpeas          | Beans       |
| Pastures         | Chicken (meat)  | Tobacco          | Maize       |
| Temperate Fruits |                 | Groundnuts       | Cotton      |
| Wheat            |                 | Soyabeans        | Potato      |
| Tangerines       |                 | Pigeonpeas       | Rabbits     |
| Millet           |                 | Work Oxen        | Donkeys     |
| Sunflower        |                 | Dairy Cattle     | Sheep       |
|                  |                 | Chicken (eggs)   |             |
|                  |                 | Goats            |             |

## MACHINGA ADD

| Priority I       | Priority II     | Priority III | Priority IV  |
|------------------|-----------------|--------------|--------------|
| Maize            | Vegetables      | Sorghum      | Sesame       |
| Cassava          | Sweet Potato    | Chillie      | Coconut      |
| Rice             | Pigeonpeas      | Pastures     | Velvet beans |
| Burley Tobacco   | Beans           | Chickpeas    | Castor       |
| Cotton           | Tropical Fruits | Soyabeans    | Guabeans     |
| Groundnuts       | Other tobacco   | Grams        | Cashew       |
| Chickens         | Cowpeas         | Groundbeans  | Potato       |
| Macadamia        | Sunflower       | Millet       |              |
| Cattle           | Rabbits         | Ducks        |              |
| Goats            | Doves           |              |              |
| Temperate Fruits | Pigs            |              |              |
| Sheep            |                 |              |              |

## MZUZU ADD

| Priority I | Priority II   | Priority III | Priority IV |
|------------|---------------|--------------|-------------|
| Maize      | Finger Millet | Sweet Potato |             |
| Cassava    | Banana        | Potato       |             |
| Beans      | Sunflower     | Cowpeas      |             |
| Groundnuts | Tomato        | Groundbeans  |             |
| Rice       | Orange        | Guava        |             |
| Cotton     | Cabbage       | Pigeonpeas   |             |
| Coffee     | Mango         | Sorghum      |             |
| Tobacco    | Soyabeans     | Spices       |             |
| Chicken    | Onion         | Doves        |             |
| Cattle     | Sheep         | Ducks        |             |
| Goats Pigs | Rabbits       |              |             |

## SHIRE VALLEY ADD

| Priority I      | Priority II | Priority III | Priority IV |
|-----------------|-------------|--------------|-------------|
| Maize           | Rice        | Dolicus      | Beans       |
| Sunflower       | Pigeonpeas  | Sesame       | Soyabeas    |
| Sorghum         | Beans       | Pastures     | Green gram  |
| Cotton          | Cassava     | Rabbits      |             |
| Tobacco         | Sheep       | Ducks        |             |
| Pearl Millet    | Doves       | Ducks        |             |
| Cowpeas         |             |              |             |
| Guarbeans       |             |              |             |
| Sweet Potato    |             |              |             |
| Tropical Fruits |             |              |             |
| Chicken         |             |              |             |
| Goats           |             |              |             |
| Cattle          |             |              |             |
| Pigs            |             |              |             |

## MACHINGA ADD

| Priority I      | Priority II     | Priority III   | Priority IV  |
|-----------------|-----------------|----------------|--------------|
| Cassava         | Maize           | Cashew         | Pasture      |
| Sorghum         | Rice            | Coconut        | Castor       |
| Sunflower       | Sweetpotato     | Dolicus beans  | Guarbeans    |
| Vegetables      | Tropical Fruits | Beans          | Sesame       |
| Soyabeans       | Chillie         | Other tobaccos | Groundbeans  |
| Barley Tobacco  | Chickpeas       | Ducks          | Velvet beans |
| Pigeonpeas      | Cowpeas         |                | Wheat        |
| Cotton          | Millet          |                | Potato       |
| Macadamia       | Rabbits         |                | Doves        |
| Groundnuts      | Goats           |                |              |
| Cattle          | Sheep           |                |              |
| Temperate Fruit |                 |                |              |
| Chicken         |                 |                |              |

## MZUZU ADD

| Priority I      | Priority II | Priority III  | Priority IV |
|-----------------|-------------|---------------|-------------|
| Finger Millet   | Maize       | Cashew nuts   | Spices      |
| Sunflower       | Rice        | Guava         | Sorghum     |
| Beans           | Soyabeans   | Pigeonpeas    |             |
| Cassava         | Groundnuts  | Macadamia     |             |
| Banan           | Tobacco     | Dolicus beans |             |
| Sweet potato    | Cotton      |               |             |
| European Potato | Mango       |               |             |
| Tomato          | Onion       |               |             |
| Groundbeans     | Cowpeas     |               |             |
| Coffee          | Cabbage     |               |             |
| Cattle          | Sheep       |               |             |
| Goats           | Pigs        |               |             |
| Poultry         |             |               |             |

## SHIRE VALLEY ADD

| Priority I      | Priority II | Priority III  | Priority IV |
|-----------------|-------------|---------------|-------------|
| Sorghum +       | Soyabeans   | Cotton        | Rice        |
| Peal Millet     | Groundnuts  | Dolicus beans | Beans       |
| Tropical Fruits | Sunflower   | Sesame        | Cassava     |
| Guarbeans       | Pigeonpeas  |               |             |
| Tobacco         | Cattle      |               |             |
| Sweetpotato     | Goats       |               |             |
| Pasture         | Sheep       |               |             |
| Rabbits         |             |               |             |

## SALIMA ADD

| Priority I  | Priority II     | Priority III  | Priority IV |
|-------------|-----------------|---------------|-------------|
| Maize       | Pasture Sorghum | Guava         | Pineapple   |
| Cotton      | Groundnuts      | Pigeonpea     | Ducks       |
| Tobacco     | Sweetpotato     | Finger millet |             |
| Tomato      | Cowpeas         | Sunflower     |             |
| Goats       | Beans           | Groundbeans   |             |
| Chicken     | Rice            | Cassava       |             |
| Chillie     | Chomolia        | Donkeys       |             |
| Soyabeans   | Carrot          | Turkeys       |             |
| Okra        | Eggplants       | Pigeons       |             |
| Pumpkins    | Spices          | Dairy cattle  |             |
| Onion       | Amaranthus      |               |             |
| Mango       | Local Rape      |               |             |
| Beef Cattle | Citrus          |               |             |
| Sheep       | Pawpaw          |               |             |
| Pigs        | Rabbits         |               |             |

## Appendix IX. Crop and Livestock Prioritisation and Ranking at National Level by DAR and ADD

| Crop/Livestock   | DAR Rank * | ADD Rank | Total Score | Final Score<br>(DAR x ADD) |
|------------------|------------|----------|-------------|----------------------------|
| Poultry          | 4          | 1        | 4           | 1                          |
| Tropical Fruits  | 1          | 6        | 6           | 2                          |
| Cattle           | 3          | 4        | 12          | 3                          |
| Vegetables       | 6          | 3        | 18          | 4                          |
| Maize            | 14         | 2        | 28          | 5                          |
| Coffee           | 21         | 14       | 294         | 24                         |
| Cotton           | 4          | 8        | 32          | 6                          |
| Groundnuts       | 7          | 5        | 35          | 7                          |
| Citrus           | 2          | 14       | 28          | 5                          |
| Rice             | 6          | 9        | 54          | 8                          |
| Cassava          | 14         | 4        | 56          | 9                          |
| Beans            | 10         | 8        | 80          | 10                         |
| Pigeonpeas       | 8          | 12       | 96          | 12                         |
| Tree Nuts        | 5          | 19       | 95          | 11                         |
| Sunflower        | 12         | 10       | 120         | 14                         |
| Goats            | 17         | 7        | 119         | 13                         |
| Sweet Potato     | 18         | 9        | 162         | 15                         |
| Soybeans         | 15         | 11       | 165         | 16                         |
| Deciduous Fruits | 11         | 15       | 165         | 16                         |
| Millet           | 23         | 10       | 230         | 19                         |
| Spices           | 10         | 20       | 200         | 17                         |
| Cowpeas          | 13         | 16       | 208         | 18                         |
| Sheep            | 21         | 11       | 231         | 20                         |
| Potato           | 9          | 18       | 162         | 15                         |
| Pastures         | 22         | 12       | 264         | 22                         |
| Pigs             | 17         | 16       | 272         | 23                         |
| Sorghum          | 20         | 13       | 260         | 21                         |
| Wheat            | 16         | 19       | 304         | 25                         |
| Chickpeas        | 24         | 19       | 456         | 27                         |
| Rabbit           | 24         | 17       | 408         | 26                         |

\* No.19 is Tea which is not under DAR's mandate.

## Append X Crop/Livestock Priority list by DAR, ADD and the final combined priority list at National level.

| DAR<br>Non-DAR<br>Priority<br>Mandate | ADD<br>Priority | National<br>(DAR x ADD) | Minor<br>Crop/Livestock<br>Crops | Non-DAR<br>Mandate<br>Crops |
|---------------------------------------|-----------------|-------------------------|----------------------------------|-----------------------------|
| Tropical Fruit Poultry                | Poultry         | Groundbeans Tea         |                                  | Tobacco                     |
| Coffee Maize                          | Tropical Fruit  | Dolicus Beans           | Tobacco                          | Tea                         |
| Citrus                                | Vegetables      | Cattle                  | Sesame                           | Sugar                       |
| Sugarcane                             |                 |                         |                                  |                             |
| Cattle                                | Cattle          | Vegetables              | Castor Bean                      |                             |
| Cotton                                | Cassava         | Maize Grams             |                                  |                             |
| Poultry                               | Groundnuts      | Coffee                  | Dove                             |                             |
| Tree Nuts                             | Tropical Fruit  | Cotton                  | Turkeys                          |                             |
| Rice                                  | Goats           | Groundnuts              | Donkeys                          |                             |
| Vegetables                            | Beans           | Citrus                  | Work Oxen                        |                             |
| Groundnuts                            | Cotton          | Rice                    |                                  |                             |
| Pigeonpeas Rice Cassava               |                 |                         |                                  |                             |
| Beans                                 | Sweet Potato    | Beans                   |                                  |                             |
| Spices Sunflower                      | Pigeonpeas      |                         |                                  |                             |
| Mushroom                              | Millet          | Tree Nuts               |                                  |                             |
| Deciduous Fruit                       | Soyabeans       | Sunflower               |                                  |                             |
| Sunflower                             | Sheep           | Goats                   |                                  |                             |
| Cowpeas                               | Pigeonpeas      | Sweet Potato            |                                  |                             |
| Irish Potato                          | Pastures        | Soybeans                |                                  |                             |
| Maize                                 | Sorghum         | Deciduous Fruit         |                                  |                             |
| Cassava                               | Coffee          | Millet                  |                                  |                             |
| Soyabeans                             | Citrus          | Spices                  |                                  |                             |
| Wheat                                 | Deciduous Fruit | Cowpeas                 |                                  |                             |
| Pigs                                  | Cowpeas         | Sheep                   |                                  |                             |
| Sweet Potato                          | Pigs            | Potato                  |                                  |                             |
| Millet                                | Rabbits         | Pastures                |                                  |                             |
| Chickpeas                             | Potato          | Pigs                    |                                  |                             |
| Guarbeans                             | Tree Nuts       | Sorghum                 |                                  |                             |
| Sheep                                 | Wheat           | Wheat                   |                                  |                             |
| Sorghum                               | Chickpeas       | Chickpeas               |                                  |                             |
| Pasture                               | Spices          |                         |                                  |                             |
| Goats                                 |                 |                         |                                  |                             |
| Rabbits                               |                 |                         |                                  |                             |