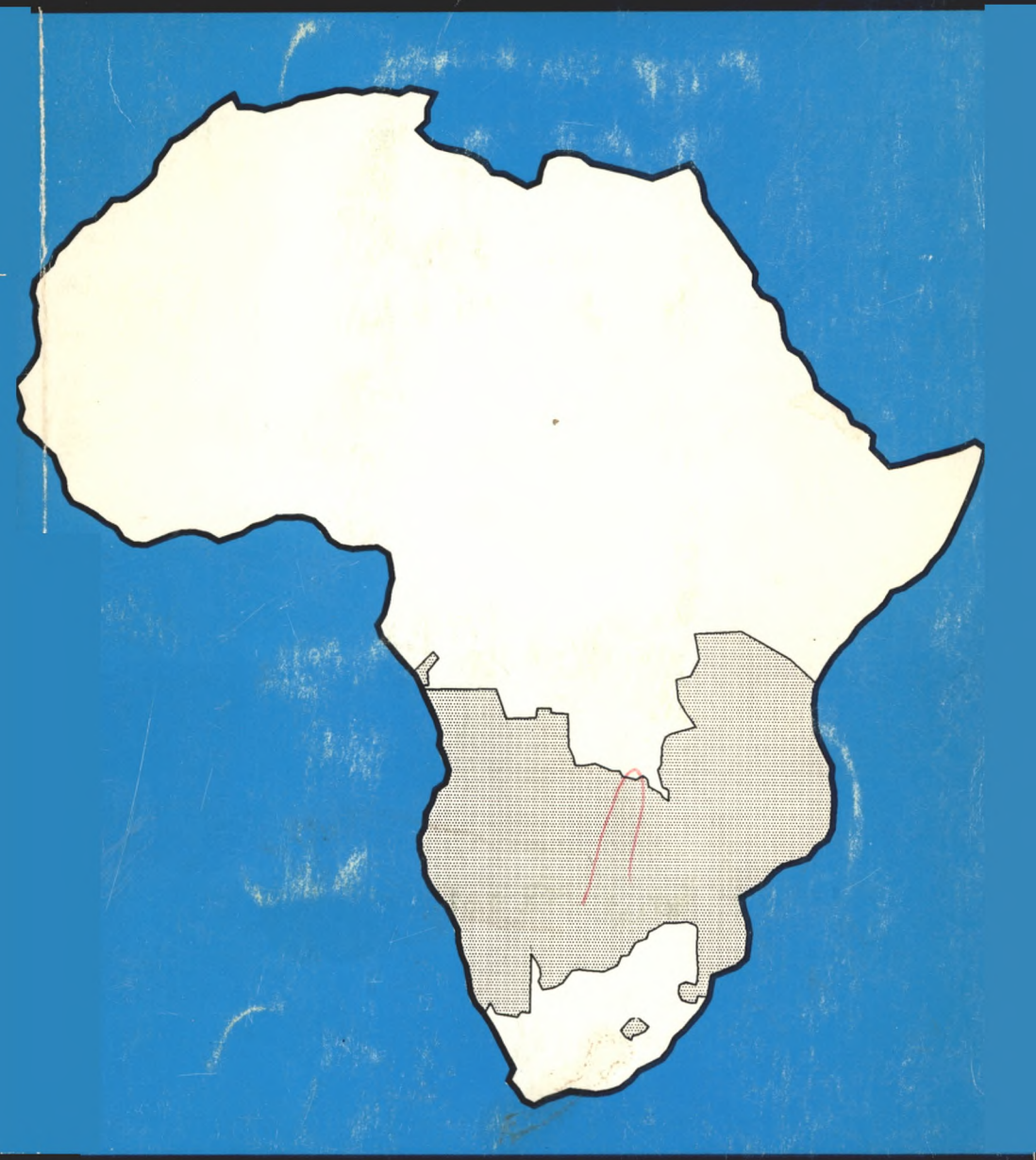
Market Reforms, Research Policies And SADCC Food Security



Edited by

Mandivamba Rukuni & J.B.Wyckoff

University of Zimbabwe UZ/MSU Food Security Research in Southern Africa Project

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UZ/MSU Food Security Research in Southern Africa Project
Department of Agricultural Economics and Extension
University of Zimbabwe
P.O. Box MP 167
Mount Pleasant, Harare, Zimbabwe
Telex 26580 UNIVZ ZW
Fax 263-4-732828
Telephone 303211 Ext.1516

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SECTION V: AGRICULTURAL RESEARCH PRIORITY SETTING AND HOUSEHOLD FOOD SECURITY

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Setting National Agricultural Research Priorities For Household Food Security: The Malawian Experience

G.Y. Mkamanga, L.D.M. Ngwira and T.J. Cusack[1]

SUMMARY

This paper presents the preliminary results of a study of strategic agricultural research priorities for the Malawi Department of Agricultural Research. The analysis used a weighted criteria (scoring) approach to generate a ranking of priorities by commodity and by research area. The study is only partly completed.

Four objectives for the research system were identified and weighted. Based on these objectives, eight criteria were selected and used to generate the following ranking of priorities by commodity: maize, roots/tubers, livestock, vegetables, tropical fruits, other grain legumes, sorghum/millet, groundnuts, rice, cotton, temperate fruits, oilseeds, wheat/barley, tree nuts and coffee. It was concluded from an analysis of current research funding that, although existing funding was in general agreement with the priorities generated by this study, opportunities remain for adjusting resource allocations to agree more closely with these priorities. In fact, these priorities are presently being used to plan resource use in the Department.

The following rank order of research priorities by crop research area were established: agronomy, plant breeding, plant protection, adaptive, irrigation/drainage, farm machinery, socio-economics, food science, soils and agroforestry, and crop storage. Research priorities by livestock research area were ranked as follows: livestock management, animal nutrition, pasture/forages, animal breeding, adaptive, food science, socio-economics and agroforestry, and

[1]Director of the SADCC Regional Gene Bank and formerly Chief Agricultural Research Officer in the Malawi Department of Agricultural Research; Deputy Chief Agricultural Research Officer for Research Programmes in the Malawi Department of Agricultural Research; and Agricultural Economist in the Malawi Department of Agricultural Research, respectively.

farm machinery. The highest priority commodity/research area combinations were found to be maize breeding and agronomy.

Heavier weighting of objectives related to food security concerns did not change significantly the commodity rankings. However, food security concerns are being increasingly recognised in research planning and are being increasingly addressed in research programmes.

INTRODUCTION

The Department of Agricultural Research (DAR) must establish priorities and allocate its limited resources among competing programmes to optimise the attainment of national goals and objectives. Research operational funding continues to be very limited while the demand for research services in increasing. Substantial investments in human and fixed resources are expected to continue. The Chief Agricultural Research Officer (CARO) is forced to mediate demands of scientists from various disciplines and commodity areas, scientists outside of DAR, donor agencies, extension and regional administrators, and -- less directly -- of farmers, consumers and agro-industries.

The presence of conflicting demands on the limited available research resources reflects the fact that demanders of new technologies and institutions may place differing weights on national goals and objectives. Although farmers and extensionists are amongst those most aware of problems and constraints, scientists are more knowledgeable about what it is possible to achieve through research. Administrators must also balance national needs and occasionally place demands on the research system in response to short-term "crises". Formal priority-setting procedures, such as the one employed in this study, assembles and analyses information to bring together demands for, and supplies of, new technologies and institutions in light of the relative values (weights) placed on given goals and objectives. The priority-setting process can also be used to explore the implications for research programming of placing alternative weights on objectives, for example, by placing additional weight on food security objectives.

The credibility of DAR's research priorities is enhanced among high-level administrators and aid donors when priorities are carefully and transparently established, making it easier to justify research programmes and associated budgets. The priority-setting process provides internal information for DAR to justify long and short term allocations of resources between individual research teams, increasing the stability of research programmes. Most importantly, annual project planning, long-term human resource development and facilities planning are facilitated.

The DAR has long recognised the need for explicit determination of research priorities (Malawi Government, 1983, and World Bank, 1985). A formal study of research priorities is presently being implemented in the DAR (Ngwira, Mwenda

and Cusack, 1990a.), and will be completed in April 1991. Some initial results are presented in this paper.

METHODOLOGY

The relative merits of the various structured methods that have been used for selecting agricultural research priorities are detailed in Norton and Pardey (1987). The method chosen for this study is a scoring approach developed at the International Service for National Agricultural Research (ISNAR), where specific commodities and research areas are ranked by defining and weighting multiple criteria. For an example of this approach, see Cessy *et al.* 1989. This method was chosen over more sophisticated methods because:

- this is the most conceptually defensible procedure given the allocated time frame for the study (six months) and present availability of data, and,
- this method is the most transparent and is readily understood by non-specialists.

The scoring approach involves identifying objectives for the research system, obtaining weights for those objectives, choosing a set of criteria by which to measure the contribution of each commodity or type of research to the objectives, collecting data on the criteria and then applying the weights on objectives to arrive at a ranking by commodity and by research area. The approach incorporates a substantial quantity of subjective information. Fortunately, these subjective judgements are relatively transparent and this facilitates understanding and testing of the sensitivity of results to alternative judgements.

Prior to collection of data for the study, it was necessary to define goals and objectives for the research system and to choose criteria through which to determine commodity priorities. It was also necessary to define the separate commodities and research areas to be prioritised. These decisions were taken by DAR Management prior to and during a visit to ISNAR (Ngwira, Mwenda and Cusack, 1990b.).

DEFINITION OF GOALS, OBJECTIVES AND CRITERIA

Goals and objectives of the research system, Table 1, were selected in accordance with the Malawi Statement of Development Policies (Malawi Government, 1987) and the DAR Research Master plan (Malawi Government, 1988a.). The primary efficiency goal is to improve the average level of well-being through economic growth. Distributional and stability goals are also included.

Table 1
Goals, objectives and criteria for DAR research.

	GOALS		OBJECTIVES		CRITERIA FOR DETERMINING RESEARCH PRIORITIES
1.	Improve the average well-being of all households. (efficiency)	1.	Increase the average level of net benefits to all producers and consumers. (income, productivity, foreign exchange, efficiency).	1. 2. 3. 4. 5.	Value of production. Expected yield increase or cost reduction over 5 years. Expected probability of research success. Expected level of adoption by farmers. Expected change in future demand.
2.	Improve the well-being of particular groups. (distribution)	2. 3.	Give additional weight to rural income growth. Give additional weight to low income/nutrition households.	6. 7.	Percent of farmers producing the commodity. Percent of each commodity consumed in same household where it is produced.
3.	Improve the stability of level of well-being (stability)	4.	Reduce year-to-year fluctuations in income/nutrition.	8.	Annual variation in value of production.

The efficiency goal was translated into the objective of increasing the average level of net benefits to all producers and consumers. This implies a desire to increase productivity, efficiency and foreign exchange. Five measures relating the contribution of individual commodity research to the efficiency objective were identified as follows:

- *Value of Production:* Research benefits can be expected to increase in relation to how widely applicable the research results are as research costs are relatively independent of the units over which results are applicable.

- *Expected Yield Increase of Cost Reduction:* An important determinant of increased productivity is the expected per unit increase in yield or cost reduction of successful research over the next five years. This value is independent of expected farmer adoption rates, assumes two man-years of scientist time for each commodity and includes the possibility of transferring/adopting technologies already available in other countries.

- *Probability of Research Success:* This estimates the probability of obtaining the yield increases or cost reductions assumed above.

- *Adoption Rates:* This is the ceiling level (maximum expected percentage) of anticipated adoption of the research results by farmers.

- *Future Demand:* Research benefits will be greater for those commodities with expanding demand than for those with stable or declining demand.

The distributional goal was translated into the objectives of giving additional weight to activities benefiting the largest number of smallholder families, and to giving additional weight to the less commercialised (lower income and lower nutritional status) smallholders. Two measures relating the contribution of research on individual commodities to the distributional objectives were identified as follows:

- *Percentage of Farmers Producing the Commodity:* The greater the proportion of farmers producing the commodity, the greater the level and distribution of benefits to villagers will be. Demand for commodities is assumed to be elastic. Thus the more producers, the more benefit generated by an outward shift in the supply curve.

- *Percentage of Commodity Consumed in the same Household Where Produced:* Low-income producers consume a greater proportion of what they produce than high-income producers. Improvements in food production for lower nutritional status households should carry extra weight.

The stability goal was translated into the objective of reducing year-to-year income fluctuations. The criterion of annual variation in the value of production was chosen to measure the extent of the risks associated with the commodity mix.

The weights assigned to the objectives by DAR Management were 85 percent for the efficiency objectives and five percent each for the distributional and stability objectives. Specific food security related concerns represent approximately 15 percent of the total weighting. As explained later, the implications of using alternative weightings were explored.

DEFINITION OF COMMODITIES AND RESEARCH AREAS

The DAR makes strategic allocations of research resources on the basis of "commodity teams". There are 29 commodity teams, listed in Table 2, consisting of 15 specific commodities or commodity groups and 14 research areas which have independent funding and whose activities usually cut across a number of commodities. The 15 commodities which are listed in Table 3, were prioritised without further sub-division into specific crops or livestock as commodity teams

are the principal targets of strategic funding decisions. The chosen research areas, also listed in Table 3, are the principal fields of activity in the DAR, and some represent existing non-commodity research teams. Some existing commodity teams (for example Produce Inspection and Seed Services) are in fact almost entirely service operations and are not included in the prioritisation analysis.

Table 2
List of commodity teams in the Department of Agricultural Research 1990-91

Maize	Rice
Wheat, Barley and Finger Millet	Sorghum and Pearl Millet
Temperate Fruits	Tree nuts
Coffee	Roots and Tubers
Vegetables	Groundnuts
Cotton	Oilseeds
Other Grain Legumes (OGL)	Livestock
Pastures	Soil Physics and Chemistry
Soil Microbiology	Soil Survey
Irrigation and Drainage	Farm Machinery
Agroforestry	Plant Protection and Quarantine
Produce Inspection	Nematology
Entomology	Seed Services
Crop Storage	
Agricultural Economics, Statistics and Data Processing	

Table 3
List of research commodities and research areas used for prioritisation in this study

RESEARCH COMMODITIES OR COMMODITY GROUPS	RESEARCH AREAS
Maize	Plant Breeding
Rice	Agronomy
Wheat Barley And Finger Millet	Plant Protection
Sorghum And Pearl Millet	Farming Systems
Temperate Fruits	Socio-Economics
Tropical Fruits	Food Science
Tree Nuts	Pastures And Forages
Coffee	Soils
Roots And Tubers	Irrigation And Drainage
Vegetables	Farm Machinery
Groundnuts	Agroforestry
Cotton	Crop Storage
Oilseeds	Livestock Management
Other Grain Legumes (OGL)	Animal Nutrition
Livestock	Animal Breeding

RESULTS: COMMODITIES

The results of the prioritisation of commodities are presented in Table 4. The judgements involved in obtaining rankings are preliminary and will be revised following substantial input from researchers and extension staff.

Referring to Table 4, the estimated smallholder production value for each commodity is based on the average annual volume of production during the 1985-90 period and 1990-91 market prices. Data sources were the Final Crop Estimates (Malawi Government, various years) and the FAO Production Yearbook (FAO 1989) for production and ADMARC 1990-91 smallholder price schedules (Malawi Government 1990a.) and the "local Market Price Surveys" conducted by the Planning Division of the Ministry of Agriculture (Malawi Government 1988b.) for market values. Commodities are displayed in Column 3 of Table 4 according to rank order of production value.

Table 4
Use of scoring model to determine agricultural research priorities by commodity

Commodity	Product Value (a)	Rank (1)	Increm. Yield	Prob. Success	Adopt. Level	Future Demand	Effic. Index (b)	Effic. Rank	Percent Farmers	Farmer Rank	Home Consump.	Consump. Rank	Annual Variat	Weighted Total (c)	Rank (2)	Weighted Total (d)	Rank (3)	Weighted Total (e)	Rank (4)
Maize	365 715	1	0.80	0.50	0.20	1.06	31 013	1	90	2	80	2	10	1.55	1	2.65	1	1.30	1
Roots/ Tubers	73 913	2	0.35	0.35	0.60	1.06	5 759	2	20	7	60	5	6	2.60	2	3.80	3	3.20	3
G/nuts	47 066	3	0.20	0.40	0.10	1.06	399	8	30	5	25	8	15	8.20	8	8.60	8	7.55	8
Livestock	41 500	4	0.80	0.50	0.20	1.06	3 519	3	95	1	50	6	1	2.95	3	2.85	2	3.15	2
O.G.L	29 259	5	0.20	0.40	0.25	1.06	620	6	26	6	50	6	9	6.15	6	6.45	6	6.00	6
Cotton	25 201	6	0.20	0.30	0.10	1.04	157	10	5	10	0	14	13	10.35	10	11.05	12	10.60	10
Vegetables	22 325	7	0.25	0.40	0.60	1.06	1 420	4	75	3	70	4	7	4.10	4	4.30	5	3.85	4
Trop. Fruits	20 047	8	0.25	0.40	0.60	1.06	1 275	5	75	3	80	2	2	4.60	5	3.80	3	4.25	5
Rice	12 874	9	0.20	0.40	0.15	1.03	159	9	7	8	10	9	11	9.05	9	9.15	9	8.85	9
Sorghum/ Millet	4 873	10	0.50	0.40	0.55	1.03	552	7	7	8	90	1	14	7.10	7	7.30	7	6.25	7
Oilseeds	1 004	11	0.25	0.35	0.20	1.06	19	12	1	11	5	10	8	11.65	12	10.95	11	11.55	12
Wheat/ Barley	874	12	0.25	0.45	0.10	1.03	10	13	1	11	5	10	12	12.70	13	18.50	14	12.25	13
Temp. Fruits	405	13	0.25	0.40	0.60	1.03	25	11	1	11	5	10	5	10.65	11	9.95	10	10.85	11
Coffee	240	14	0.20	0.20	0.20	1.00	2	15	1	11	0	14	4	14.20	15	19.90	15	14.25	15
Tree Nuts	63	15	0.25	0.40	0.60	1.04	4	14	1	11	5	10	3	13.10	14	11.30	13	12.95	14

a: value of production is in thousands of September 1990 Kwachas.
b: efficiency index = (value prod.) * (increm. value) * (prob. success) * (adopt. level) * (Future demand)
c: weighted total = ,85(effic. rank) + ,05(farmer rank) + ,05(consump. rank) + ,05(annual variat.)
d: weighted total = ,55(effic. rank) + ,15(farmer rank) + ,15(consump. rank) + ,15(annual var.)
e: weighted total = ,70(effic. rank) + ,15(farmer rank) + ,15(consump. rank)
Rank(1) is based on production value; Efficiency rank is based on the efficiency index;
Rankings (2), (3) and (4) are based on the appropriate weighted totals.

The efficiency criteria 2-4 (Columns 4-6 of Table 4) were measured by senior researchers and extension staff at a DAR/ISNAR workshop held in Mzuzu, Malawi, in May, 1990. Estimates of the fifth efficiency criterion, expected future change in demand for the commodity, were obtained from the Planning Division in October, 1990.

Combining the efficiency criteria results in a new ranking of commodities (Column 9 of table 4). The distribution/stability criteria were measured with the assistance of data and personnel from the Planning Division and the Department of Agriculture. Incorporation of these factors into the analysis results in ranking commodities (Column 16 of Table 4) in accordance with the weights originally assigned to the objectives. The remaining columns of Table 4 explore the effects of alternative weighting systems on commodity ranking.

The results indicate that, whatever the weighting system used, maize remains the highest-ranked commodity and is in a separate highest-ranked category. The final rankings are presented in Table 5

Roots and tubers and livestock remain highly-ranked throughout but groundnuts loses its high-priority ranking, becoming a medium-ranked commodity, when all of the efficiency factors are included. The values attached to the efficiency criteria for groundnuts may need to be revised as they appear out-of-line with those estimated for vegetables, oils and livestock. Sorghum and millet in particular are consistently ranked higher than groundnuts despite having only ten percent of the value of groundnut production.

Other Grain Legumes, vegetables and tropical fruits retain their medium ranking throughout the weighting alternatives except that tropical fruits attain a "high" ranking when emphasis is placed on distribution and stability ("food security") objectives.

Rice retains its low ranking throughout the weighting systems while sorghum and millet attains a medium ranking with all weightings. Cotton is demoted from medium to "low" or "very low" with all weightings.

Oilseeds, wheat/barley, temperature fruits, coffee and tree nuts retain their "very low" rankings throughout the alternative weightings.

The main rankings of commodities according to priority for research appear reasonable with the exception of groundnuts which appear to have been given too low a priority because of some inconsistent estimates of the efficiency criteria 2-4. Further refinement of the data is probably needed to provide a more secure basis for the rankings obtained.

By changing from a "best estimate" to a "food security" weighting, rankings do not change significantly although the values of the indices for livestock and tropical

fruits (which are relatively widely grown), show relatively little annual variation in production and are largely consumed within the household, improve somewhat.

Table 5
Ranking of research priorities by commodity

		Best (Rank 2) Estimate	Rank (3)	Rank (4)	Rank (1)
Highest-Ranked:	1.	Maize	1	1	1
High-Ranked:	2.	Roots/Tubers	3	3	2
	3.	Livestock	2	2	4
Medium-Ranked:	4.	Vegetables	5	4	7
	5.	Tropical Fruits	3	5	8
	6.	Other Grain Legumes	6	6	5
	7.	Sorghum/Millet	7	7	10
	8.	Groundnuts	8	8	3
Low-Ranked	9.	Rice	9	9	9
Lowest-ranked	10.	Cotton	12	10	6
	11.	Temperate Fruits	10	11	13
	12	Oilseeds	11	12	11
	13	Wheat/Barley	14	13	12
	14	Tree nuts	13	14	15
	15	Coffee	15	15	14

Notes:
Rank (3) is generated from high "food security" weighting of objectives.
Rank (4) if generated from a moderate "food security" weighting.
Rank (1) is based entirely on estimates of national value of production.
Source: Table 4 - See text and Table 4 for explanation of the bases of rankings.

RELATIONSHIP BETWEEN PRIORITIES AND FUNDING OF COMMODITIES

The procedure used for ranking the research priorities presented in Tables 4 and 5 is intended to maximise the possibility that the most researchable problems of farmers and the most promising opportunities are investigated by the research establishment within the framework of the nation's goals. A framework is presented which facilitates reasoned judgements based on inputs from a wide range of authorities. For this initial stage of the analysis, inputs from senior researchers, senior extension and planning staff and from DAR Management were prominent.

The responsibility for allocation of the limited human, physical and capital resources of the DAR lie with the Chief Agricultural Research Officer. DAR priorities are manifested in the allocations of these resources between the various commodity teams by CARO. Allocations of these strategic resources within commodity teams are largely the responsibility of Commodity Team Leaders.

CARO is assisted in arriving at resource allocation decisions through an annual planning and review exercise involving senior DAR management and researchers, senior extension staff, and senior technical planning and management staff from outside DAR. It is intended that the analysis of priorities presented here would assist with the process. In fact, that has been the case for the 1990 exercise which is almost completed (Ngwira and Cusack, 1990). The present study is being undertaken as an early activity in the updating of a DAR Master Plan for Agricultural Research.

The extent to which research resources may need to be reallocated depends on the disparity between priorities and existing resource allocation. This paper does not attempt to review allocations of all resources between commodity teams as this exercise is not yet completed. However, the recent allocations of Government operating funds to the various commodity teams is a key indicator of overall resource allocation and, therefore of assigned priorities. The disposition of other resources to research follows the pattern of allocation of Government operating funds.

Levels of operating funds allocated to the various commodity teams, and the equivalent rankings, for the years 1989, 1990 and (proposed) 1991 are summarised in Table 6.

Research priorities appear to have shifted significantly over the three year period. In general, expenditures have moved closer to the Rank (2) results. Changes in DAR resource allocations appear to be achieving closer synchronisation with the perceived optimum:

- for the six commodities in the lowest-ranked commodity group, Table 5, out of an "optimal" score of 74 (the sum of the rank numbers) the scores in 1989, 1990 and 1991 were 56, 60 and 68 respectively;

- for the three commodities in the high and highest ranked groups, out of an "optimal" score of 6, the scores in 1989, 1990 and 1991 were 16, 12 and 6 respectively; and,

- for specific commodities -- maize moved from second to the highest-ranked position, roots and tubers moved from eleventh to third, other grain legumes moved from twelfth to seventh, vegetables increased from thirteenth to eighth, while cotton, coffee and tree nuts have fallen significantly in ranking.

Table 6
Comparison of priority rankings of research commodities, based on the scoring model and on the level of Government expenditures

	Scoring Model Results			Level of Government Expenditures				Current Kwacha	
	Product Value	Rank	Rank (2)	1991	1991	1990	1990	1989	1989
Commodity	(a)	(1)	Best Estimate	Level	Rank	Level	Rank	Level	Rank
Maize	365 715	1	1	367 578	1	116 659	2	115 773	2
Roots/Tubers	73 913	2	2	292 290	3	56 655	7	34 936	11
Groundnuts	47 066	3	8	163 375	5	74 213	5	68 460	4
Livestock	41 500	4	3	324 447	2	107 407	3	91 158	3
O.G.L.	29 259	5	6	109 258	7	60 868	6	33 960	12
Cotton	25 201	6	10	199 089	4	131 084	1	118 518	1
Vegetables	22 325	7	4	97 050	8	39 461	12	30 303	13
Trop. Fruits	20 047	8	5	93 942	9	47 272	10	45 230	6
Rice	12 874	9	9	157 036	6	75 763	4	65 229	5
Sorg/Millet	4 873	10	7	76 427	11	45 537	11	39 903	8
Oilseeds	1 004	11	12	63 967	12	31 524	14	27 149	14
Wheat/Barley	874	12	13	50 886	14	24 586	15	18 307	15
Temp. Fruits	405	13	11	40 000	15	35 756	13	37 530	10
Coffee	240	14	15	91 057	10	50 658	8	39 145	9
Tree Nuts	63	15	14	59 959	13	49 072	9	43 746	7

Notes: The scoring model results are taken from Table 4. Levels of Government expenditures for 1989 and for 1990 are actual allocations. Levels of Government Expenditures for 1991 are levels requested by the Department of Agricultural Research.

Comparing the 1991 Rank and Rank (2) in Table 6 reveals that further adjustment in resource allocation may be needed to approach the "optimum". Existing resource allocation appears to be relatively excessive for cotton, rice, groundnuts, coffee and tree nuts, while existing resource allocations appear to be too limited for vegetables, tropical fruits and sorghum/millet.

Reasons why cotton and rice attract excessive resources are:

- these commodities have relatively limited alternative funding sources so it is expected that their rankings will erode when an "all resources" base is used for comparison; and,

- these commodities provide a strong commercial base in areas of relatively poor agro-ecological conditions where few production alternatives exist. There is little organised international research for cotton or pool of technology on which to draw.

The 1991 ranking of groundnuts is more closely related to Rank (1). The Rank (2) ranking for this commodity will move closer to the 1991 ranking after the revisions discussed earlier.

The trend of reduced allocations to coffee and tree nuts is expected to continue. The DAR is presently completing a programme for transferring much of this research work to independent research entities. This process takes time to ensure adequate continuity to research activities.

The relatively low 1991 allocations to sorghum/millet compared to Rank 2 is offset somewhat by: (a) possible over-ranking of this commodity (indicated above), and (b) sorghum/millet attracts substantial external funding thus would appear as a higher priority in an "all resources" assessment. Vegetables and tropical fruits will continue to attract increasing resources as these programmes further develop towards indigenous needs rather than specialised exotics.

RESULTS : RESEARCH AREAS

The results of the prioritisation of research areas are presented in Tables 7A and 7B. The preliminary work on research area prioritisation has not been completed so these results represent only an initial step. Respondents were assigned the task of completing Tables 7A and 7B identifying high potential research areas for increasing the next five years farm productivity with existing research or somewhat increased resources.

Table 7a shows the results with weights assigned to each research area within a commodity. For crops, the highest priority is plant breeding and agronomy, medium priority to plant protection and adaptive, and low priority to the other research areas. For livestock, the highest ranking is livestock management, followed by animal nutrition, pastures/forages, medium priority to animal

breeding and adaptive, and low priority to the other research areas. The ranking of research areas according to research priorities is presented in Table 8.

If weights are assigned to each of the commodities within a research area, the highest priority commodity/research area combinations become apparent. These are maize breeding and agronomy for crops -- poultry, nutrition and management for livestock. Table 7b illustrates a check on the results of the commodity rankings of Table 4. These are reasonably consistent for crops. But other grain legumes and cotton are relatively high while wheat/barley are low. No separate rankings are given for livestock in Table 4 but these are implied in Table 7B showing a rank order of poultry, sheep/goats, dairy, beef and pigs.

CONCLUSIONS

Attention on food security concerns continues to increase at all levels in planning and implementing rural development activities in Malawi. This was recently highlighted in a September 1990 national Food Security and Nutrition Policy Statement published as a supplement to the Malawi Statement of Development Policies (Malawi Government, 1990b). The present paper shows how such concerns are reflected in contemporary decisions by the DAR in allocating research funds to specific commodities. Not only does DAR now explicitly recognise the need to address food security concerns through its commodity research programmes by formally setting research priorities through the scoring approach described in this study, but recent trends in DAR research expenditures indicate that the DAR is orienting its programme to areas more likely to address farmer food security problems. The implications for DAR's strategic funding decisions of placing emphasis on food security concerns are measured in this study. However, heavier weighting of objectives related to food security concerns did not significantly change the commodity rankings.

Although there appears to be further room for strategic reallocation of research resources within the DAR between commodities, this need is relatively minor. It may be further reduced when "all resources" results become available and revisions in the data used for generating the "best estimate" ranking (Rank 2) have been made. This study is to provide a sound basis for the overall allocation of scientists, training opportunities, foreign and domestic funding and facilities within the DAR over the next several years. Also the study is providing a useful vehicle for incorporation of a wide range of research, extension and planning views into the research planning process.

Several of the traditional commodities (maize, root crops, groundnuts, poultry, vegetables, and tropical fruits) could yield high benefits from research because small increase in productivity will be spread over a large number of households.

Table 7A

Summary of scoring results and determination of research priorities based on research areas.

Research Area / Commodity	Plant Breeding	Agronomy	Plant Protection	Irrigation Drainage	Farm Machinery	Agro-Forestry	Adaptive	Crop Storage	Soils	Livestock Management	Animal Nutrition	Animal Breeding	Pasture/ Forages	Socio-Economics	Food Science	Total
Maize	30	20	5	5	5	5	5	10	5					5	5	100
Rice	20	25	8	15	5	1	5	5	10					5	1	100
Wheat/barley	35	30	10	1	5	1	6	1	5					5	1	100
Sorg/millet	20	30	10	1	5	10	15	5	1					1	2	100
Temp. fruits	40	40	10	1	1	1	1	1	1					2	2	100
Trop. fruits	24	20	10	5	1	5	20	1	1					3	10	100
Tree nuts	20	40	30	1	2	1	1	0	2					2	1	100
Coffee	30	20	30	2	1	3	7	0	2					5	0	100
Roots/tubers	14	20	10	5	1	5	15	10	5					5	10	100
Vegetables	10	20	5	10	5	5	15	5	5					5	15	100
Groundnuts	30	20	10	5	10	5	10	1	3					5	1	100
Cotton	25	20	20	5	5	1	13	1	5					5	0	100
Oilseeds	20	30	20	5	5	1	10	1	2					5	1	100
O.G.legumes	20	20	10	2	2	5	20	3	8					5	5	100
Crops Only																
Total Weight	338	355	188	63	53	49	143	44	55					58	54	
Rank	2	1	3	5	6	9	4	11	9					7	8	
Livestock																
Poultry					5	5	10			25	20	15		5	5	
Dairy					5	5	10			20	20	10	20	5	5	
Beef					5	5	10			20	10	10	30	5	5	
Sheep/goats					5	5	10			20	15	15	20	5	5	
Pigs						5	10			20	20	20	10	5	10	
Livestock Only																
Total weight					20	25	60			105	85	70	80	25	30	
Rank					8	7	5			1	2	4	3	7	6	

Notes:
For explanation see text. Respondents were asked to take each commodity and then assign weights to each of the research areas.
Higher weights indicate higher research priority.

Table 7B
Summary of scoring results and determination of research priorities based on commodities, by assigning research area weights.

Research Area / Commodity	Plant Breeding	Agronomy	Plant Protection	Irrigation Drainage	Farm Machinery	Agro-Forestry	Adaptive	Crop Storage	Soils	Livestock Management	Animal Nutrition	Animal Breeding	Pasture/ Forages	Socio-Economics	Food Science	Total Weight	Rank
Maize	20	10	8	16	20	50	20	50	30					20	10	254	1
Rice	5	6	10	10	10		5	1	20					2	5	63	8
Wheat/barley	4	1	5	5	1		1		3					2		22	13
Sorg/millet	5	6	5	1	10	10	4	5	3					4	5	49	10
Temp. fruits	4	5	5	1	1	1	1		3					1		22	13
Trop. fruits	4	10	6	8	1	5	5	3						3	10	55	9
Tree nuts	4	5	10	1	5	5	1		3					2		36	12
Coffee	5	5	10	5	5	5	1		3					1		40	11
Roots/tubers	5	6	10	10	1	5	10	10	3					8	20	88	3
Vegetables	4	10	6	15	1	1	10	20	2					5	20	94	2
Groundnuts	10	6	5	5	12	1	8	5	10					8	5	75	6
Cotton	10	10	10	10	13	1	8		10					8		80	5
Oilseeds	10	10	5	5	5	1	8	1	10					8	5	68	7
O.G.legumes	10	10	5	5	5	10	8	5	10					8	10	86	4
Crops Only																	
Total Weight	100	100	100	97	90	95	90	100	100					80	90		
Livestock																	
Poultry					3	1	3			40	40	30	5	8	1	131	1
Dairy				1	3		2			20	30	25	30	5	4	120	3
Beef				1	1	1	1			5	5	5	25	1	1	46	4
Sheep/goats				1	2	2	3			30	20	30	30	5	3	126	2
Pigs					1	1	1			5	5	10	10	1	1	35	5
Livestock Only																	
Total Weight				3	10	5	10			100	100	100	100	20	10		
TOTAL	100	100	100	100	100	100	100	100	100						100		

Notes: For explanation see text. Respondents were asked to take each research area and then assign weights to each of the commodities. Higher weights indicate higher research priority.

Table 8
Ranking of research priorities by research area

RANKING	CROPS		LIVESTOCK
High-Ranked	1	Agronomy	1 Livestock Management
	2	Plant Breeding	2 Animal Nutrition
			3 Pasture/Forages
Medium-Ranked	3	Plant Protection	4 Animal Breeding
	4	Adaptive	5 Adaptive
Low-Ranked	5	Irrigation/Drainage	6 Food Science
	6	Farm Machinery	7 Socio-Economics
	7	Socio-economics	8 Agroforestry
	8	Food Science	9 Farm Machinery
	9	Soils	
	10	Agroforestry	
	11	Crop Storage	

Source: Table 7A

This study does not consider priority-setting by researchers within specific commodities. However, this is equally important. (Commodity Team Leaders are required to express and justify their research objectives and priorities through an Action Plan which is sent to CARO for approval and provides the basis for medium-term research activities within the team.)

The analysis presented in this paper is preliminary because data collection is not completed and, even when a consensus is reached on the results, the analysis will represent only one, crucial aid to CARO in making resource allocation decisions. All priority-setting procedures are subjective because of their predictive nature and the fact that values of key factors in the analysis rely upon scientists' opinions. It is expected that refinements will be made from time-to-time as additional data become available.

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