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INTERNATIONAL CONSULTING DIVISION

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CHEMONICS

FINAL EVALUATION REPORT

MALAWI AGRICULTURAL RESEARCH AND EXTENSION (MARE) PROJECT (612-0215)

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LIST OF ACRONYMS

ACAEO (Crops)	Assistant Chief Agricultural Extension Officer (Crops)
ACAETO	Assistant Chief Agricultural Extension and Training Officer
ACAO	Assistant Chief Agricultural Officer (Extension and Training) - (renamed ACAETO in May 1992)
ACAO	Assistant Chief Agricultural Officer (Crops) - (renamed ACAEO (Crops) in May 1992)
ADD	Agricultural Development Division
ADMARC	Agricultural Development and Marketing Corporation
AGREDAT	Agricultural Economics and Data Unit
ARC	Agricultural Research Council
ARP	Adaptive Research Program
ARPCU	Adaptive Research Program Coordinating Unit
ART	Adaptive Research Team
AVRDC	Asian Vegetable Research and Development Center
BES	Block Extension System
CAETO	Chief Agricultural Extension and Training Officer
CAO	Chief Agricultural Officer - (renamed CAETO in May 1992)
CARO	Chief Agricultural Research Officer
CAS	Controller of Agricultural Services
CID	Consortium for International Development
CIMMYT	International Maize and Wheat Improvement Center
CRT	Commodity Research Team
CTO	Chief Technical Officer
CTrO	Chief Training Officer
DAET	Department of Agricultural Extension and Training
DAR	Department of Agricultural Research
DAHI	Department of Animal Health and Industry
DCAETO	Deputy Chief Agricultural Extension and Training Officer
DCAO	Deputy Chief Agricultural Officer - (renamed DCAETO in May 1992)
DLH	Department of Land Husbandry - (established in May 1992)
DOA	Department of Agriculture - (renamed DAET in May 1992)
DTC	Day Training Center
EAB	Extension Aids Branch
EAU	Extension Aids Unit
EPA	Extension Planning Area
FA	Field Assistant
FHA	Farm Home Assistant
GDP	Gross Domestic Product
GOM	Government of Malawi
GTZ	German Foreign Aid Agency (Gesellschaft fur Technische Zusammenarbeit)
HA	Hectare

IBRD	International Bank for Reconstruction and Development (World Bank)
ICARDA	International Center for Agricultural Research in Dry Areas
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
IITA	International Institute for Tropical Agriculture
IDA	International Development Association (World Bank)
IGA	Income Generating Activities
INTSOY	International Soybean Center
ISNAR	International Service for National Agricultural Research
MAEPS	Malawi Agriculture Extension and Planning Support Project
MARE	Malawi Agriculture Research and Extension Project
MK	Malawi Kwacha (May 1992: 1 US Dollar = 3 MK)
MOA	Ministry of Agriculture
MPT	Multi-purpose tree
MZADD	Mzuzu Agricultural Development Division
NARCU	National Adaptive Research Coordinating Unit
NARP	National Agriculture Research Program
NRCUs	National Commodity Research Coordinating Units
NRC	Natural Resources College
NRCU	National Research Crop Unit
NRDP	National Rural Development Program
NSCM	National Seed Company of Malawi
ODA	Overseas Development Administration (UK)
OPC	Office of the President and Cabinet
OSU	Oregon State University
PACD	Project Assistance Completion Date
PCP	Pilot Communications Project
PD	Planning Department
PIL	Project Implementation Letter
PM	Program Manager
PO	Professional Officer
PS	Principal Secretary
RDP	Rural Development Project
SACA	Smallholder Agricultural Credit Administration
SAO	Senior Administrative Officer
SMS	Subject Matter Specialist (Extension)
TA	Technical Assistant
TOT	Training of Trainers
TRIM	Tea Research Institute of Malawi
T&V	Training and Visit System
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VAO	Visual Aids Officer
VAU	Visual Aids Unit
WID	Women in International Development
WPS	Women's Programme Section
WPO	Womens Programme Officer

PROJECT IDENTIFICATION DATA SHEET

1. Country: Malawi

2. Project Title: Malawi Agricultural Research and Extension project

3. Project Number: 612-0215

4. Project Dates:

   a. First Project Agreement: 9/24/85
   b. Obligation Date: Initial 7/18/85; Amended 4/20/89
   c. Most Recent Project Assistance Completion Date (PACD): 9/30/92

5. Project Funding:

a. AID Bilateral Funding (Grant)	US $15.00 million
b. Other Major Donors: World Bank (IDA)	35.70 million
c. Host Country Counterpart Funds	33.06 million
Total	US $83.76 million

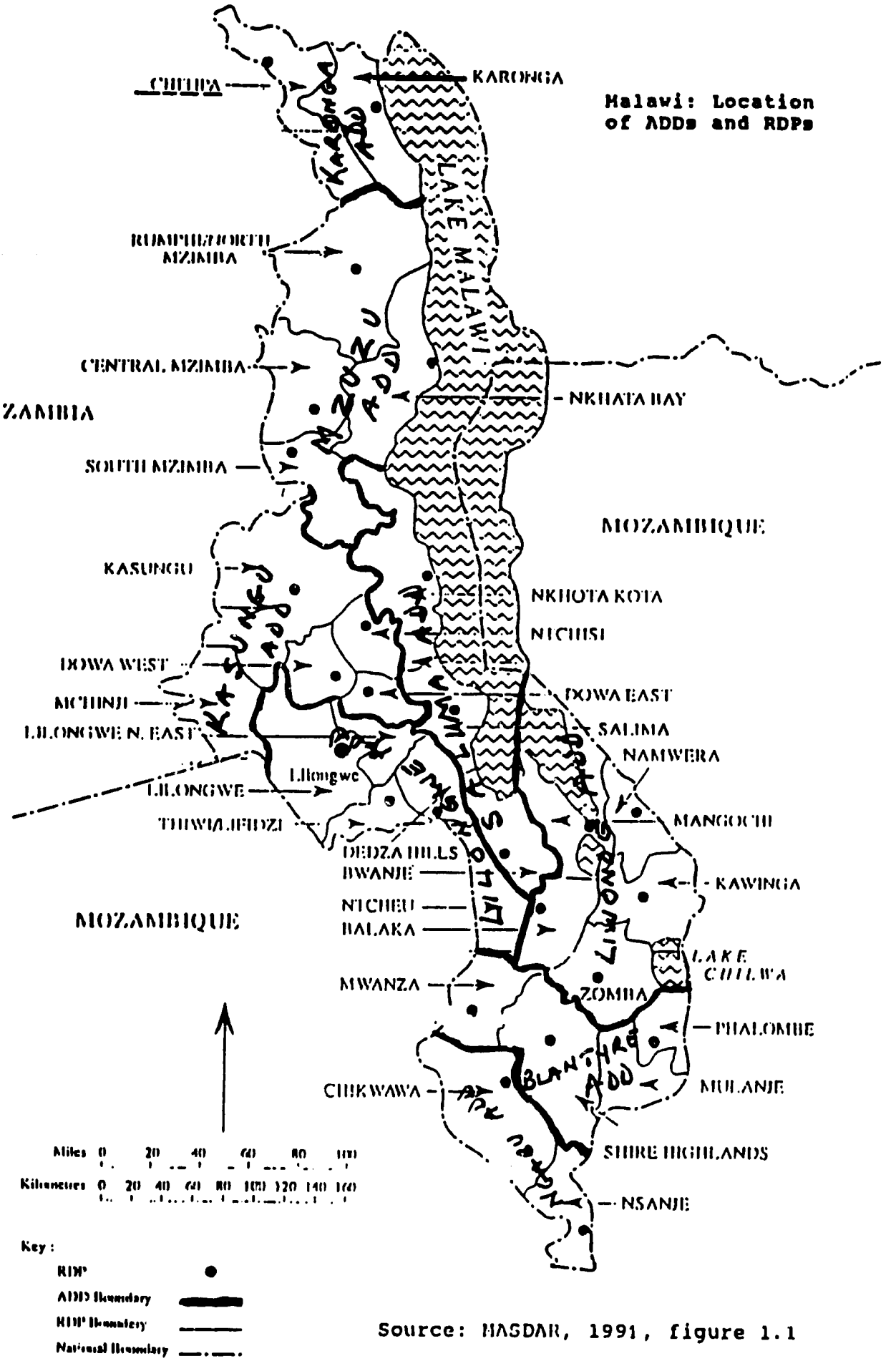
6. Mode of Implementation: Ministry of Agriculture with technical assistance under USDA and AID direct contracts with Consortium for International Development

7. Project Designers: USAID/Malawi and the Government of Malawi

8. Responsible Mission Officials:

a. Mission Directors:	John Hicks	9/85-6/88
	Carol Peasley	8/88-PACD
b. Project Officers:	Arnold Radi	9/85-5/90
	Joanne Hale	7/90-PACD

9. Previous Evaluations: Mid-Term Evaluation/SUNY-1/25/89
   Non-Federal Audit/Peat Marwick-12/89



Source: HASDAR, 1991, figure 1.1

EXECUTIVE SUMMARY

A. OBJECTIVE OF PROJECT

The Malawi Agricultural Research and Extension (MARE) project was designed to improve the institutional capacity of the Ministry of Agriculture (MOA) to increase the production and productivity of traditional crops and to identify the most viable crops for diversifying smallholder production. The project contains three distinct components:

- **Training.** Aimed at institutionalizing training at the ministry level, this component was expected to provide research personnel with the enhanced skills required for developing smallholder technologies and to provide extension staff with improved abilities for disseminating appropriate agricultural technologies.

- **Research.** This component was intended to assist the Department of Agricultural Research (DAR) in generating appropriate technologies for improving the productivity of traditional crops and in identifying new crops for diversifying smallholder production. Research activities were focused on increasing the returns to land and labor employed in the production of traditional crops (especially maize) and on identifying crops for diversifying smallholder production which could provide higher incomes, employment, and foreign exchange generation. This component was expected to produce relevant localized technology packages for dissemination to smallholders through the extension program.

- **Extension.** Agricultural extension was to be strengthened in terms of institutional linkages with agricultural research and its ability to disseminate research recommendations to smallholders. This was to be achieved by utilizing communication support to more effectively cover the smallholder population, by responding to specific needs of female smallholders, and by linking extension efforts to applied adaptive research systems.

Authorized in July of 1985, the principal contractor under the project was the Consortium for International Development (CID), with Oregon State University (OSU) serving as the lead institution. Under the contract there were to be seven long-term technical assistants, fifty-five months of short-term assistance, training, and commodity procurement. Two USDA technical assistants were also financed under the project. A total of 48 participants were sent to the United States for M.Sc. and Ph.D. level training. A mid-term evaluation of the project was performed in early 1989. As a result of the evaluation team's findings and recommendations, the project was extended two years, with the last of the technical assistants scheduled to leave in August of 1992.

B. PURPOSE AND METHODOLOGY OF THE EVALUATION

The primary purpose of the MARE final evaluation is to measure the degree to which the project goal, sub-goal, and purpose level indicators and output targets, as contained in the Logical Framework (Annex A), have been achieved. The final evaluation is also expected to identify any unexpected or unplanned project impacts, provide an explanation for any indicators or output targets which were not achieved, and state what lessons can be learned from the MARE implementation experience. The final evaluation Scope of Work is attached as Annex B.

In many instances MARE's overall impact is difficult to separate from the impact of other donor-funded projects. The World Bank is the most active in the agricultural sector, with numerous initiatives. Given that the time frame for institution building and technology transfer is generally longer than six years, it is safe to assume that there are benefits from the MARE project that can be identified in the future but not at this time.

In addition, perspective is gained by viewing MARE's stated objectives and accomplishments within the context of USAID's past and future activities. The project preceding MARE, the Malawi Agricultural Research project, sought to strengthen the MOA principally through improvements in research capacity. The target of MARE was somewhat broader, meant to address aspects of agricultural extension in addition to the larger research component. The next project, the Agricultural Sector Adjustment Program, continues the thrust by promoting extension in agroforestry and aiming at reducing the policy and institutional barriers that limit smallholder access to productive inputs and rewarding markets. Viewed as such, MARE is one of many efforts contributing to this cumulative process of institutional strengthening of the research and extension system.

The macroeconomic conditions during significant portions of MARE's implementation adversely affected the agricultural sector in general and smallholders in particular. The shocks include a decline in external terms of trade, an increase in the cost of borrowed capital, and droughts. Between 1988 and 1990, smallholder agriculture contracted by an annual average rate of -0.9 percent. Estate agriculture grew by 9 percent during the same period.

C. TEAM COMPOSITION AND PROCEDURES

Chemonics International fielded a six-member team to conduct the MARE final evaluation. The team reviewed MARE project publications (Annex C) and other pertinent publications, reports, and documents (Annex D). The first half of the three-week in-country evaluation period was spent meeting and conducting interviews with appropriate MOA staff, technical assistants, other donor personnel, and USAID staff (Annex E). Also, site visits and interviews were conducted at research stations. The last half of the period was devoted to preparation of the initial draft of this report and then discussing it in sessions with relevant personnel at the ministry and the USAID mission, as well as among team members. These discussions, minutes of these discussions, and redrafted sections provided the major input for preparation of the final report.

D. FINDINGS OF THIS EVALUATION

The MARE project has been successful in contributing, along with the Government of Mali (GOM) and other donors, to a viable research and extension system in Malawi. This system is already showing some increased returns and will show greatly increased returns soon, probably within the next two to five years.

The overall strengthening of the maize, agroforestry, and horticulture programs is already providing new materials and ideas to farmers. More site-specific research and on-farm evaluation of these technologies will help reduce the overall cost of national recommendations from the annual *Guide to Production* and identify new areas for future research. The Forestry Department is now providing acacia seedlings to farmers. Increasingly, quantities of hybrid maize, chemical fertilizer, and credit are becoming available to male and female smallholders.

There is a growing recognition among public officials and agencies of the need to increase maize yields and overall land productivity while also reducing the requirements for chemical fertilizer. The research programs are responding to these needs. Research and extension personnel are becoming more confident of their ability to respond to the constraints on smallholders.

There have been significant improvements in the quality and timeliness of extension material diffused. There also appear to have been increases in the number of smallholder farmers reached in the MARE-supported Pilot Communications Project (PCP). There were improvements in the teaching process as a result of the "training of trainers" program and the extension communications program. Within the Women's Program, increased numbers of farmers were reached. Components of the research and extension system have been strengthened; however, they have yet to function as an integrated system that gives adequate attention to the adaptability of technology.

The predecessor to the MARE project had a large impact on the maize program, and the MARE project had some impact on it too. The MARE project has substantially contributed to strengthening the research and extension system in agroforestry, horticulture, and economic analysis.

Furthermore, in the face of economic stagnation in the smallholder sector over most of the life of the project, most of the objectively verifiable indicators from the project's Logical Framework (Annex A) are positive in varying degrees. It should be noted that a number of the assumptions listed in the Logical Framework have not withstood the test of time.

The following points, which are covered in more detail in Sections II and III, respond to each of the end-of-project-status questions in the Scope of Work:

- **Training.** In the face of serious personnel and funding constraints, the training unit is doing an outstanding job. The staff is energetic, well organized, and

capable, and they have made intelligent use of the technical assistance provided through MARE.

While the impact of such intensive and extensive training on the MOA is difficult to assess, it has been very great. The research and extension system has been perturbed by series of donor interventions and outside shocks, in addition to the intermittent absence of key personnel to long-term training programs. It will take some time for the system to readjust to a new equilibrium, and the process will undoubtedly demand patience and good judgement on the part of all concerned.

The 48 Ph.D. and M.Sc. programs provided by the project have and will continue to make a major impact on the extension and research system.

- **Agricultural Research Council.** The Agricultural Economics and Data Unit (AGREDAT) has made a substantial contribution to research priority identification and planning. The current scoring mechanisms are important to improving research resource allocation. Further work needs to consider all activities of the DAR and the Department of Agricultural Training and Extension (DAET), and within them, commodity program resource allocations. The Agricultural Research Council (ARC) needs to be a smaller body with regular attendance of the same personnel. Maintaining and improving the capacity of AGREDAT requires action now to retain trained staff.

- **National Commodity Research Coordinating Units (NRCUs).** Five NRCUs are conducting research on economically viable smallholder technologies. The MARE project provided long-term technical assistance to only two units, the Agroforestry Commodity Research Team (CRT) and the Horticultural NRCU. However, it provided training to staff members from all five units. The dedication and hard work of these researchers, complemented by the adaptive research program on-farm trials, led to the release of two flint-type maize hybrids, MH17 and MH18, in 1990. This is a remarkable achievement, which will contribute to major increases in maize production over the next two to five years.

  The MARE agroforestry technical assistant (TA) led activities that laid a sound foundation for a significant impact on agricultural sustainability and food security in Malawi. Management recommendations have been developed and farm tested for several key technologies. Some of these recommendations will appear for the first time in the 1992/93 *Guide to Agricultural Production*. For all practical purposes, the agroforestry work in Malawi began with the initiation of MARE project. Therefore, the accomplishments in agroforestry described in this report are a direct result of the project.

  The two MARE horticultural TAs have made significant contributions in strengthening the entire horticultural research program. In addition to providing on-the-job training to Malawian researchers in many areas, they also actively participated in research, on-farm trials, surveys, and marketing studies. The many

demonstration trials that have been initiated at extension training centers and on smallholder farmers' fields resulted in improved researcher-extension staff-farmer linkages. They also increased production of mango, citrus, and avocado in the Liwonde Agricultural Development Division (ADD); cabbage, tomato, apple, and peach in the Blantyre and Lilongwe ADDs; and indigenous vegetables in the Ngabu ADD.

- **Adaptive Research Teams (ARTs).** While the general opinion is that adaptive research is an excellent concept and an essential component of technology development and diffusion, its application has not met expectations. Since inception of the project, ARTs have operated on average with one professional officer rather than the allocated two. This was due initially to professional officer M.Sc. study leaves. Yet, the pattern continues to date. Currently, of the seven established ARTs, three have both professional officers at post, and the remaining four have only one. Other officers, particularly the socioeconomists, have resigned and undertaken employment elsewhere in the agricultural sector.

  It is clear that the Adaptive Research Program (ARP) has sharply focused attention on the need for and difficulty of obtaining regionalized recommendations. It is also clear ARP has substantially improved the system's ability to collect and analyze data on constraints faced by farm families. The continued need for adaptive research is not being questioned. Now the challenge is to mold an overall system within which adaptive research is fully integrated and functioning effectively. This should receive priority attention. It may be appropriate to commission a study to further investigate the role of adaptive research in the context of the overall system.

- **Extension Institutions.** There is a significant increase in the media production capacity of the Extension Aids Branch (EAB) and Visual Aids Units (VAUs), stemming from the project's provision of training opportunities, facilities, and media equipment. Both the quality and speed of delivery of publications and other communications has been greatly enhanced. The EAB has demonstrated its ability to reflect women's involvement in agricultural production in its agricultural communications outputs.

  The MOA has adopted for its agricultural communications strategy the concept and methodology developed and tested through the project-sponsored Pilot Communication Project. As a pilot project, the PCP has demonstrated that its systematic approach to agricultural communications can improve extension message quality, farmer-extension linkages, and the training of field-level extension staff. Current evidence, to be reviewed in light of the summative evaluation of the PCP, suggests the PCP process positively influences the adoption of extension recommendations.

- **Women's Program.** During the six years of support from the MARE project, the MOA has made great progress in the integration of women farmers and

professionals into the ongoing programs of extension, credit, and training. As an effective agent in this process, the Women's Program has been active in reshaping policy. It has implemented a series of income-generation projects and trained both male and female extension workers to work more productively with women farmers.

The MOA has been particularly successful in increasing the number of women farmers who receive credit through farmers groups. In 1982-83, only 8.3 percent of such credit was going to women. In 1985-86, the first year of the project, women were receiving 19.4 percent, and by 1990-91, they were receiving 34.4 percent.

The ability of the Women's Program to support women farmers in shaping the research agenda has been more problematic. With the difficulties of the ARTs, this influence has virtually disappeared. Since women provide up to 70 percent of the farm labor and also make many of the production, processing, and storage decisions, their lack of voice in the research process remains a serious concern.

E. LESSONS LEARNED FROM THIS PROJECT

The MARE project was relatively well designed, except for three things: the lack of attention to soil science in the system, an overestimation of the number of new technologies ready to be extended to smallholders, and its greatly reduced support for the maize program.

The MARE project's predecessor made a substantial contribution to the maize program. The MARE project design included only modest support for the maize program, just at the time the program was in a position to start producing new technology. The decision to reduce support seriously compromised the potential impact of the program. Fortunately, the Rockefeller Foundation was able to fill the gap. This lesson is directly applicable to the agroforestry program and to the horticultural program, now that they are able to start producing technology.

A different system of USAID project management was tried, one without a chief of party. A U.S.-based project coordinator and the MOA controller of agricultural services (NRDP) were responsible for overall project management. The long-term TAs were fully integrated into the MOA structure. Most persons connected with the project believe that the arrangement worked quite well.

Participant training was a well-conceived and important project component. A high percentage of project funding was spent for graduate level training for qualified personnel, with the idea that upon their return the MOA's institutional capacity would be strengthened. Unfortunately, the loss of trained personnel has become a serious problem. The MOA must look at its ability to retain qualified personnel and take appropriate action. The potential adverse impact of the continued loss of the trained personnel who are responsible for the production and diffusion of new technology is very great.

The funding of recurrent costs remains a major problem. Major infrastructure has been built, people have been trained, and laboratories have been equipped. Making available modest operating funds at this stage is essential to building a high quality research and extension system. There has been a failure to provide even modest levels of operating funds for many key research and extension activities. Mechanisms must be found for this support.

The MARE project has compelled the MOA to reassess its priorities, particularly regarding on-farm research. The need for regionalized recommendations is clear. The project was expected to mold a system which could deliver more site-specific recommendations. Only limited progress was made, suggesting this process is more difficult than anticipated.

One of the project's objectives was to help diversify smallholders' production and income base. Generally speaking, this has not happened. Nevertheless, future income increases should result from the solid research programs in agroforestry and horticulture. The economic conditions for smallholders have been very difficult due to structural reforms reducing subsidies to farmers and repeated droughts. The agroforestry and grain legumes research programs will help use technologies and management practices to reduce fertilizer requirements. Moreover, revising the research priorities would put more emphasis on cassava and sorghum-millet, thereby increasing the ability to withstand droughts. Substitution of maize by such other crops as sorghum, sweet potato, cassava, and banana should be encouraged.

SECTION I
INTRODUCTION

A. OVERVIEW

The importance of agricultural production to Malawi's economy is undisputed. Agriculture supports at least 85 percent of the population, officially employs over 46 percent of the labor force, produces approximately 40 percent of GDP, and accounts for over 90 percent of export earnings. Agricultural production is divided into two sectors, smallholder and estate. The resulting dualism has implications for access to inputs, markets, services, and pricing structure of agricultural products.

Smallholders produce on customary or traditional land and are responsible for 80 percent of the nation's basic food crop. Crops they may grow include maize, groundnuts, pulses, cassava, sorghum, millet, and rice. The expansion of the estate sector has coincided with the shrinking of average land holding in the customary land area, with more than half of all smallholders cultivating less than one hectare. Smallholders have no direct access to international markets and sell their export crops to the Agricultural Development and Marketing Corporation (ADMARC). On average, it retursn 21 percent of international market prices to smallholders for their cotton, groundnuts, and tobacco. ADMARC is the sole supplier of subsidized fertilizer which is made available to farmers who are members of credit clubs.

The estate sector, which operates on freehold and leasehold land, has benefitted from a set of agricultural policies that provide favorable credit, a nominal tax rate on land holdings, and inexpensive labor. The sector also benefits from leakages of subsidized inputs from the smallholder sector. Land held by estates accounts for 25 percent of land available for agriculture. Production represents nearly 90 percent of agricultural export earnings and is highly concentrated in burley and flue-cured tobacco, tea, and sugar, which has made the sector susceptible to price fluctuations on the world market. Nevertheless, the estate sector registered substantial growth in the 1980s.

The MARE project was designed to improve the institutional capacity of the MOA to increase the production and productivity of traditional crops and to identify the most viable crops for diversifying smallholder production. The project contains three distinct components:

- **Training.** Aimed at institutionalizing training at the ministry level, this component was expected to provide research personnel with the enhanced skills required for developing smallholder technologies, and to provide extension staff with improved abilities for disseminating appropriate agricultural technologies. It was also expected to serve as the principal mechanism for sharing information and expertise

between and among the DAR, DOA, the Planning Department (PD), and smallholder farmers.

- **Research.** This component was intended to assist the DAR in generating appropriate technologies for improving the productivity of traditional crops and in identifying new crops for diversifying smallholder production. Research focused on increasing the returns to land and labor employed in the production of traditional crops, especially maize, and on identifying crops for diversifying smallholder production and providing higher incomes, employment, and foreign exchange earnings. This component was expected to produce localized technology packages to disseminate to smallholder farmers through the extension program. It was also to be linked with training through the provision of technical and scientific information and the participation of research personnel in the training program. Joint planning sessions by the DAR and the DOA to set research priorities were expected to be an integral part of the effort.

- **Extension.** Agricultural extension was to be strengthened in terms of institutional linkages with agricultural research and its ability to disseminate research recommendations to smallholders. This was to be done by using more effective communication support to cover the smallholder population; responding to specific needs of female smallholders; and linking extension efforts to applied adaptive research systems.

Authorized in July 1985, the principal contractor under the project was the Consortium for International Development, with Oregon State University serving as the lead institution. Under the contract, seven long-term technical advisors, fifty-five months of short-term assistance, training, and commodity procurement were to be provided. Two USDA advisors were also financed under the project. A total of 48 participants were sent to the United States for M.Sc. and Ph.D. level training. A mid-term evaluation of the project was performed in early 1989. As a result of the evaluation team's findings and recommendations, the project was extended two years, until 1992.

B. PURPOSE OF THE EVALUATION

The primary purpose of the MARE final evaluation is to measure the degree to which the project goal, sub-goal, and purpose level indicators and output targets, as contained in Annex A, the Logical Framework, have been achieved. The final evaluation is also expected to identify and quantify any unexpected or unplanned project impacts, provide an explanation for any indicators or output targets which were not achieved, and state what lessons can be learned from the MARE implementation experience. The final evaluation Scope of Work is attached as Annex B.

In many instances MARE's overall impact is difficult to separate from the impact of other donor-funded projects. The World Bank is the most active donor in the agricultural sector. Its numerous initiatives include: the Agricultural Marketing and Estate Development program; National Agricultural Research program; Agricultural Research and

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Planning; Smallholder Credit program; Agricultural Services project; and finally, Agricultural Sector Adjustment Credit. There is considerable agreement among those interviewed that a substantial degree of synergism among donor efforts is at work.

Given that the time frame for institution building and technology transfer is generally longer than six years, it is safe to assume there are MARE benefits that can be quantified only in the future. Annex F provides further discussion on technology transfer in Malawi's agricultural sector.

In addition, perspective is gained by viewing MARE within the context of USAID's activities. The project preceding MARE, the Malawi Agricultural Research project, sought to strengthen the MOA principally through improvements in research capacity. The target of MARE was somewhat broader, including aspects of agricultural extension in addition to the larger research component. The next project, the Agricultural Sector Adjustment program, continues the thrust by promoting agroforestry extension and reducing the policy and institutional barriers that limit smallholder access to productive inputs and rewarding markets. Viewed as such, MARE is one of many efforts contributing to this cumulative process of institutional strengthening.

The macroeconomic conditions during significant portions of MARE's implementation adversely affected the agricultural sector, particularly smallholders. The shocks included a decline in external terms of trade, increases in the cost of borrowed capital, and droughts. Between 1988 and 1990 smallholder agriculture contracted by an annual average rate of -0.9 percent. Estate agriculture grew by 9 percent in the same period.

C. TEAM COMPOSITION AND PROCEDURES

Chemonics International was requested to field a five-member team to conduct the MARE evaluation. The team was composed of an agricultural economist (team leader) with 33 years of experience in agricultural project design and evaluation; an agricultural economist (Ph.D.) with extensive experience in quantifying the economic impact of agricultural research and extension efforts; an agricultural extension/communications specialist (Ph.D.) with over 15 years of experience in project design, implementation, and management; a WID/training specialist (Ed.D.) with 15 years of experience in WID and training activities in the agriculture/rural sector of Africa; and an agronomist (Ph.D.) with extensive experience in the evaluation of agricultural research in Africa. In addition to the five team members, an economist provided by Chemonics joined the team to assist with research and report preparation.

The team reviewed the MARE project publications listed in Annex C and other pertinent publications, reports, and documents listed in Annex D. The first half of the three-week evaluation period was spent meeting and conducting interviews with appropriate MOA staff, returned participants, CID/OSU technical assistants, other donor personnel, and USAID staff. Site visits and interviews were also conducted at research stations. The individuals contacted by the team are listed in Annex E. The last half of the evaluation period was devoted to the preparation of the first draft of this report, which was submitted to

the USAID mission and the MOA on May 29th, and redrafting report sections during the last several days in Malawi. On June 3rd, the day before the team departed from Malawi, the first draft of the report was discussed at length in sessions with relevant MOA and USAID personnel. These discussions and minutes of these discussions, discussions among the team members, and the redrafted sections provided the team leader the major input to prepare the final report.

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SECTION II
PROJECT IMPACT VIS-A-VIS LOGICAL FRAMEWORK

A. GOAL: TO INCREASE INCOMES OF SMALLHOLDERS

A1. Impact of MARE Project on Total Production[1]

A1a. On Which Food Crops and Other Agricultural Products Have Total Production and Yields Increased?

Maize. The primary impact has been the introduction of two new maize hybrids, MH-17 and MH-18. These hybrids were introduced in 1990/91 and produced on approximately 16,000 and 48,000 ha in 1991/92 and 1992/93, respectively.

Agroforestry. The research has been done for introduction of alley cropping and for increased utilization of *Acacia albida* (*Faidherbia albida*) as partial substitutes for chemical fertilizer in maize production.

Horticulture. This is a promising future area of development, with good progress by the commodity research teams. Problems include the marketing potential and mounting the extension activities.

A1b. How Much Did Production Increase?

During the drought year of 1991/92, much of the new hybrid area was believed to have escaped crop failure. A conservative estimate of the yield increase from the two new cultivars and associated practices is one to two tons/ha, giving an increase of 16,000 to 32,000 tons of maize in this year and approximately three times this level next year. The demands for these new flints in the 1990s will make this a benchmark achievement.

A1c. What Proportion of the Increase Can Be Attributed to MARE?

MARE and its predecessor project trained the maize breeders and agronomists. There are still maize team members in training. Ph.D. training is a minimum requirement for a successful commodity research program, and a minimum unit of four to six senior scientists from different disciplines is probably required for major commodities. MARE continued supporting these training efforts, and this is now paying off for maize. Similarly, training and technical assistance from MARE helped build up the agroforestry and horticulture programs, and measurable impacts should come soon from these programs.

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[1]A detailed account of technology developed and data used for calculations and to answer these specific questions is in Annex F of this report, "Agricultural Technology Development in Malawi."

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A2. Smallholder Income and MARE Activities

A2a and A2b. Have Smallholder Income and Food Availability Increased During the Project Period?

The late 1980s and early 1990s were a difficult time for smallholders and other low-income sectors. Rainfall was low for several years, and an acute drought occurred in the 1991/92 crop year. Structural adjustment reduced the profitability of smallholder agriculture by cutting subsidies on fertilizer and maize consumption (see Sahn and Arulpragasam, 1991). Over the 1988-1990 period, smallholder income declined at a -0.9 rate (EIU, 1991, pp. 12-13). Moreover, real farm wages have fallen in the estate sector, further depressing the income of the rural poor.[2] So this has been a very difficult environment for improving agricultural productivity and incomes.

Nevertheless, the Maize Commodity Program did very well, releasing two new flint cultivars in 1990. There has been a steady increase in hybrid maize area since 1986/87. If chemical fertilizer use continues expanding and hybrid seed supplies increase, a rapid growth in maize production is possible.[3]

Increasing fertilizer use is a critical component of increased hybrid areas. Unfortunately, Malawi has one of the highest fertilizer costs in the world due to the high transportation costs of this bulky commodity. A central aspect of structural reform was to eliminate fertilizer and maize subsidies. Those subsidies benefitted low-income consumers and producers.

Fortunately, Malawi is making rapid progress with various types of agroforestry, a commodity program MARE actively supported. In the next five years these innovations should substitute for some of the chemical fertilizer required for the hybrid maize. There is also substantial potential for more rapid progress in the grain legume sector, but a more active commodity program, with stronger linkages to international networks, and a focusing of research, will be necessary over the next decade.

Production and income effects can be expected from the agroforestry and horticulture programs over the next five years, assuming sufficient governmental support for research and extension and the creation of a profitable environment for agriculture.

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[2]Over 1983-1989 the real wages of agricultural workers fell by at least one-third, according to the *Malawi Country Profile, 1991-92*, Economist Intelligence Unit, London, 1991, p 14.

[3] The GOM should begin planning to handle the price collapse likely with large output increases expected in the next two to five years. In the early 1980s, producer price increases of maize resulted in a large increase in marketed output. The GOM maintained the maize support price to farmers and sold at a lower price to consumers. As part of the structural reform from 1984-87, the maize price was substantially reduced, with a large diversion in production to other crops and even maize imports. In 1988 the maize producer price was increased by 44 percent (EIU, 1991, p. 17). A price collapse of sorghum and millet occurred in the Sahelian countries in 1986, two years after their major drought of 1984.

A2c. What Were MARE's Contribution to This Increase?

Besides the training of Malawians, excellent technical assistants were provided in the agroforestry and horticulture programs over a sufficient period to train local staff and to produce a substantial research base.

A3. Impact of MARE on Smallholder Farming Practices

A3a. What New Technologies Are Smallholders Adopting as a Result of MARE?

Direct results of the maize program are the introduction of the two new flint cultivars. The 1991/1992 *Guide to Agricultural Production* recommendations of alley cropping maize with *Leucena* and *Gliricidia* came directly from the agroforestry program. Moreover, this same guide recommends planting *Acacia* either from the Forestry Department's seedlings program or farmers' own collection. Finally, various important research initiatives and on-farm tests are ongoing in the Horticulture Department.

A3b. What is the Medium- and Long-term Effect of Technology Adoption?

A successful maize program reasonably supported with research funding and the creation of a good economic environment can continue to turn out new cultivars and assorted technologies. A more rapid adoption of new maize hybrids began in the late 1980s and is expected to accelerate in the 1990s.

There appears to be substantial potential for adoption of *Leucena* and *Gliricidia* and renewed planting of *Acacia albida*. These introductions have the potential to substantially reduce—but not eliminate—the requirements for chemical fertilizer.

With domestic economic growth and/or the infrastructure development for foreign markets, the adoption of horticulture-specialized products can also proceed in the next decade.

B. SUB-GOAL: TO STRENGTHEN DOMESTIC INSTITUTIONS TO SUPPORT SMALLHOLDERS

B1. Has the Quality of Support Services Available to Smallholder Farmers Improved as a Result of MARE?

B1a and B1b. Which Services and Which Quality Improvements Have Been Made for Smallholders?

The overall strengthening of the maize, agroforestry, and horticulture programs is already providing new materials and ideas to farmers. More site-specific research and on-farm evaluation of these technologies will help reduce the overall cost of national recommendations from the *Guide to Production* and identify new problem areas for future research. The Forestry Department is now providing *Acacia* seedlings to farmers. Hybrid

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maize, chemical fertilizer, and credit are becoming increasingly available to male and female smallholders.

Public officials and agencies show a growing recognition of the need to increase maize yields and overall land productivity, while also reducing the requirement for chemical fertilizer. These needs are being responded to by the research programs, and researchers are becoming more confident of their ability to deal with constraints in smallholder agriculture.

There have been significant improvements in the quality and timeliness of extension material. Also there appear to have been increases in the number of smallholder farmers reached in the MARE-supported Pilot Communications Project. There were improvements in the teaching process as a result of the training of trainers program and the extension communications program. Within the Women's Program, increased numbers of farmers were reached.

B1c. What Part of Quality Improvements Can Be Attributed to MARE?

The predecessor project to MARE had a large impact, and MARE had some impact on the quality improvements in the maize program. The present project has substantially contributed to quality improvements in the research-extension services in agroforestry and horticulture and also in economic analysis.

C. PURPOSE: TO IMPROVE THE MOA'S CAPACITY TO INCREASE PRODUCTIVITY OF TRADITIONAL CROPS AND TO IDENTIFY THE MOST VIABLE CROPS FOR DIVERSIFYING SMALLHOLDER PRODUCTION

The indicators of success in achieving the above-stated purpose are discussed below under each of the End-of-Project-Status questions listed in the Annex B, "Scope of Work for MARE Project Final Evaluation."

End-of-Project Status

C1. Training[4]

Is the MOA Training Unit fully operational and undertaking training programs for research and extension staff?

The specific questions concerning the end-of-project status of the training component are addressed here under three topics. The questions on institutional capacity of the MOA Training Unit are discussed first. The questions on individuals receiving long- and short-term training funded by the project and their current locations are then addressed. The questions on impact and a discussion of the constraints to impact come last.

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[4]For a more detailed discussion of the MARE training component, see Annex G, "Impact of MARE Training Component."

C1a. Institutional Capacity of the Training Office

Given the personnel and funding constraints outlined below, the training unit is doing an outstanding job. The staff is energetic, well organized, and capable and have made intelligent use of the technical assistance provided through MARE. Their major accomplishments are listed in Annex G.

Unfortunately, the unit has had problems securing and retaining professional staff. For the first three years the unit functioned on a provisional basis with technical assistance from USDA. When the office was formally established in 1989, it was given three professional posts—a unit chief, a principal training officer, and a senior training officer—as well as an administrative officer and a computer operator. Four additional training officers were borrowed from within DOA. The unit chief's position was not filled for many months, and although someone was named to the post more than a year ago, he has not yet taken up the post. Tom Trail, the immensely capable technical assistant, left in 1990, and the senior training officer resigned to enter the private sector. Two of the four borrowed trainers are no longer available. This leaves the unit with one professional officer, two staff persons, and two borrowed trainers.

The effect of the staff shortages is that most professional time is tied up in necessary administrative tasks, and there has been a sharp reduction in the amount of technical assistance for trainers at the ADD and RDD level who have recently been trained by the program. The training of trainers (TOT) strategy the unit uses depends on such technical assistance, so these staff shortages will undoubtedly affect the long-term success of such training, unless this problem is addressed soon.

Through the TOT program, a substantial cadre of in-service trainers has been established. Unfortunately, the Woman's Program was unable to access TOT training for their staff until the last possible training session. Staff turnover is a problem at the ADD level also, and the ADDs need additional training and support from the unit to maximize their effectiveness.

The unit's operating costs are provided from the MOA recurring budget. Although this is an important marker of full institutionalization, it has meant interruptions in the flow of funds, and thus, of the training. When the unit was formally established within MOA, funds for administration and management were budgeted. Training funds were provided on a reimbursable basis, which slowed down the training because reimbursement was so slow. Nevertheless, the system worked reasonably well between 1987 and 1991. However, from April 1991 until March 1992, there were no funds for in-country training. Funding became available again in April 1992. It is not clear why the flow stopped and then started.

Between 1986 and 1989 the Training Unit Advisory Committee met two or three times a year and provided useful input. It was particularly helpful in developing selection criteria for overseas trainees and in the development of the MOA's five-year human resource development plan. However, the committee has not met since 1989, ostensibly because all

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policy issues have now been decided. It seems likely the committee could help resolve personnel and funding issues, as well as longer-range planning concerns.

C1b. Individuals Receiving Long- and Short-term Training

C1b(1). Long-term Training Overseas

Forty-eight participants received long-term overseas training at major American land grant universities, 33 from DAR and 15 from DOA. Their training was as follows:

Department	Ph.D.	Discipline	M.Sc.	Discipline
DAR	4	2 agronomy 2 horticulture	29	24 ag specialties 5 economists
DOA	0		15	5 social science 10 natural science

Twenty percent of those receiving M.Sc. level training were women; however, no women received Ph.D. level training. All but two trainees are back in country; one of those remaining is completing a PhD with government permission. Three additional M.Sc. level agronomists, one of whom is a women, began training under MARE's predecessor and finished with MARE funding.

All those who returned are working in Malawi, most within the government. The biggest losses to the government have been among economists because demand far outruns supply. From DAR, six trainees have left. Three agricultural economists went to ODA, USAID, and Estate Extension; one agronomist moved to Smallholder Sugar; and one agronomist and one agricultural engineer have gone to the Tea Research Institute of Malawi (TRIM). One participant left DOA for TRIM.

The 96-percent rate of participant returns to Malawi is exceptionally high. Combined with the fact that nearly all trainees completed their course-work in two years, efficiency of training was high and wastage very low. Considering that at least 15 did their thesis or dissertation work in Malawi, the record is even more impressive. It would be useful for the training officer to collect and list these research documents. The research documents should be centrally located and available to both Malawian and outside scholars. A seminar series for presentation of this research would also enhance Malawian research capabilities.

C1b(2). Short-term Overseas Training

Thirty-four trainees received short-term training overseas. Of these, 31 person-months were for DOA in such areas as media production, training, and income generation, and 32 person-months were for DAR in areas that included soils and vegetable, animal, and fruit production. Twenty-five percent of the trainees were women.

All trainees completed on time, and all returned to Malawi. A complete listing of overseas participants, schools, disciplines, etc., is included in Annex H, "MARE Project Long-Term Courses."

C1b(3). In-country Training

In-country training was given principally in two areas, technical training in agricultural subjects and management training. Approximately 50 technical courses are given each year to staff in DAR and DOA, much of it at or below the ADD level. MARE funds were used to improve the quality of training through TOT, as well as for provision of some outside technical assistance in such areas as irrigation, credit, plant quarantine, pesticide education, and development of annual work plans.

Three courses were also conducted on diffusion of results of agricultural research. Participants were equally divided between DAR and DOA, in a continuing effort to improve communications between the two. Workshop evaluations were positive, but assessments of their impact on improved communications have varied.

Given the structural changes in MOA related to the Commodity Research Teams and Adaptive Research Teams, substantial in-country training in management has been given. The long-term goal is development of participatory management systems. Much has been done with outside technical assistance, but there has also been an effort to build internal training capacity. This is reflected in a long-term management training strategy for MOA developed with the assistance of a USDA consultant. The approach has been thorough and systematic. It began with a series of management seminars where senior managers identified training needs for themselves and their departments.

The International Service for National Agricultural Research (ISNAR) then conducted a series of management courses for DAR personnel, and USDA conducted two courses on management of research station farms. MOA utilized expertise from Mananga in Swaziland, and ESAMI from Tanzania, as well as short courses from the Malawi Institute of Management. For sustainability, outside experts trained mid-level officers who then assisted in the training of 120 professional officers (POs) and more than 80 TOs. Follow-up sessions for the trainees are strengthening their capacity over time.

In sum, while this is an impressive effort, it is far from completed and continuing efforts must be made.

C1c. Impact of Training on MOA Capability/Performance

The impact of training on individual trainees was assessed in a study done by Long and Jimmerson (1990). Of participants in all three National Rural Development Program (NRDP) V staff training projects, 66 percent ranked their U.S. education very relevant to Malawi's agricultural development objectives, and another 26 percent ranked it somewhat relevant. Short-course respondents also ranked relevance highly. A high proportion of respondents also indicated they were utilizing on the job what they had learned and that this

utilization seemed to increase with the second position held. Since the professional life of MARE graduates back on the job was typically six to twenty years, this finding promises a long-term effect on the functioning of the MOA.

The in-country TOT program more directly targeted the ability of the extension system to communicate with farmers. Previous surveys of farmers had indicated they ranked the extension agents' technical knowledge and ability quite high but were somewhat less enthusiastic about their ability to deliver messages. The primary purpose of the TOT was to improve teaching and interaction skills of the entire extension system, from subject matter specialists (SMSs) down to the field assistants (FAs). Participants in this training consistently ranked its usefulness and relevance very highly in their evaluations at the end of the sessions and again several months later. There is substantial anecdotal evidence that these newer methods of training are percolating through the system and reaching farmers. Although there is no farmer impact study for the MARE project, use of similar methods in Malawi by the World Bank, Rockefeller, and UNICEF indicates an on-farm gain in productivity when FAs use TOT principles with smallholder farmers.

It is more difficult to assess long-term impacts of such intensive and extensive training on the MOA's functioning. Just before MARE began, the 1985 INTERPAKS study judged the ministry's technology generation and transfer system to be effective, well organized, and capable of learning from experience. In the ensuing seven years, the system has been profoundly perturbed by a series of donor interventions and outside shocks, as well as by the comings, goings, and post reassignments associated with the training process. It will take some time for the system to adjust to a new equilibrium, and the process will undoubtedly demand patience and good judgement on the part of all stakeholders.

It is a tribute to the strength, stability, and resilience of the system that it was able to function effectively through this period. Such qualities bode well for the long-term capacity of the ministry to absorb and utilize the current increase in trained personnel. The process, however, will undoubtedly take time, and there will inevitably be stresses in the system. At present, there is a great deal of "new wine in old bottles." Pressure is building in several parts of the system as highly motivated and intelligent people try to apply their training in systems that partially constrain their performance.

The absence of sufficient operating funds came up repeatedly in discussions with everyone concerned. Often it was a question of funds for relatively small amounts, such as for computer paper and disks or for sufficient paper to print 500 copies of research and extension bulletins to distribute at the Rural Development Project (RDP) and block level, rather than the current 50 copies, which is sufficient only for the ADD level. Motor fuel was an issue for transportation to both training and research sites. Finally, both the Training Office and the Women's Program experienced long-term interruptions of transportation, training, and demonstration funds from the recurring budget. These limits and interruptions do not appear to be as great as in many other countries with similar economies, but they do demand serious consideration.

Salary levels are a more complicated issue. The country now possesses significantly greater human capital and is struggling with ways to recompense those persons. The greater spread of training demands a greater spread in salaries, but higher salary differentials have recurring cost implications. Yet it is feared that lack of higher salaries will cause people to leave government service and perhaps to leave Malawi. The fear is realistic. To date, at least six MARE-trained people have left government service for the private sector, but none have left Malawi.

A recent study by a World Bank consultant found that between 1985 and 1991, 31 people, or 32 percent, of the DAR's professional staff, ones with M.Sc. or Ph.D. degrees, had left the department. This has been cited as evidence that trained personnel were being bid away by higher salaries. Closer examination of the data however, shows the data to be more complex. Ten of the persons retired, including three with Ph.D.s who went to TRIM, where the retirement age is higher than the DAR's 50 years. Three individuals were seconded to another unit. Two were promoted and transferred, including one to principal secretary (PS). Eleven resigned and are now in non-government jobs. One person absconded. The status of four is unknown.

Comparable figures for the DOA professional staff who left during the same period are not currently available, but they appear to be lower.

Thus, to date, some 10 to 15 percent of trained Malawians have left government service for private, parastatal, and donor agencies, but none appear to have left the country. Many of these seem to have left at or near the mandatory retirement age of 50. Over the longer run more may leave due to low salaries, constrained operating funds, or general frustration if the system doesn't permit them to efficiently perform the work for which they are trained. This is a real dilemma for the country and the donor community that has helped create a highly motivated, energetic group of African agricultural scientists and extension personnel. While the country badly needs them, it may not be able to afford them, at least in government service. Creative solutions are called for.

C2. Agricultural Research Council (ARC)[5]

Is the ARC specifying priorities for research and allocating funding according to these priorities?

C2a. Is the AGREDAT Fully Staffed and Functional?

Presently, the AGREDAT is fully staffed and is functional.

C2b. Are AGREDAT Staff Turnover Rates Acceptable

In most units of the DAR, there have been serious staff attrition problems. This has not happened in AGREDAT but is expected to become a problem in the immediate future.

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[5]For more details, see Annex I, "DAR Organization, AGREDAT, and the ARC."

Several staff members have either left, will be leaving, or are already late or not returning from training in North America.

C2c. Effectiveness, Methodology, and Budgetary Allocations in Setting Research Priorities?

A scoring methodology was developed by collaboration between ISNAR and DAR high-level research and extension personnel at a workshop in Mzuzu, May 1990. This methodology is a standard weighting of commodities. It reflects both efficiency and equity criteria, including value of production, expected yield increase or cost reduction, probability of research success, maximum adoption rates expected, future demand, percentage of farmers producing the commodity, and the percentage of the commodity consumed in the same household where produced (see Mkamonga, Ngwira, and Cusack, 1991, p. 27).

On the basis of these scoring criteria, all the commodity programs were ranked. These rankings were then compared with the direct budgetary allocations for each commodity. The indirect allocations from the service programs, such as the value of the soil testing done for the maize program, were then added to the direct allocation so that almost all DAR expenditures were allocated to commodity programs. This seems to be an excellent methodology for choosing among commodities.

Developing allocation criteria was also undertaken for the disciplinary mix within commodity teams, and some recommendations about priority areas among disciplines have been made. This was undertaken by asking for expert opinion on the probability of research success. Breeding and agronomy, especially in maize, are the highest recommended priorities. It was recognized that there are synergistic effects between disciplines. For further details, see Annex I.

C2d. Is the ARC Utilizing AGREDAT Analyses to Specify Research Priorities? How?

Prior to the AGREDAT rankings, allocations between commodity programs were based upon ranking according to national objectives, including import substitution and export promotion. This usually resulted in absolutely uniform changes between commodity programs.

In 1991, the ARC members received a draft of a priorities paper in the fall and an update before their April meeting. The ARC rankings were influenced by other considerations, including continuing outside pressures to invest more resources in soils. However, in general the ranking system was followed for all commodities. There were recommendations made for increases to roots and tubers and decreases to cotton. In spite of a low total area of production, sorghum and millet were recommended for increases due to their high scores of possible yield increase, high potential adoption rates, and importance for subsistence consumption. Cassava feeds approximately 2.5 million persons and sorghum/millet some 600,000 consumers, so putting more weight on those two commodity groups responds to the need to provide more food security in the country. Vegetables and

tropical fruits received high scores due to large expected adoption rates and substantial home consumption. The data gathering and record keeping to use this scoring system in 1992 was implemented into a continuing process as the DAR attempted to institutionalize this decision-making input.

C2e. Are Current Research Funding Allocations Based upon Priorities Identified by AGREDAT?

Both the maize and the soil programs benefitted substantially with new financial support based upon this priority analysis.

C2f. What Changes in Research Priorities Occurred?

There was more financial support to maize, soils, roots and tubers and less to wheat and barley and temperate fruits as a result of the AGREDAT analysis and ARC decisions.

C2g. What Has Been the Impact of These Changes?

Budget allocations for operating funds have directly followed the AGREDAT and ARC priority analyses. The staff plan for 1991 to 1996 also reflects these priorities. In this way, AGREDAT has provided an important contribution to management information systems.

C2h. Overall Evaluation of AGREDAT

The AGREDAT unit has made a substantial contribution to research prioritization and planning. Concern with staffing, maintaining, and improving AGREDAT as a strong unit needs to continue.

C3. National Commodity NRCUs

Are five National Commodity NRCUs conducting research on economically viable smallholder technologies for priority traditional and nontraditional crops?

The GOM's agricultural policy is directed at the balanced and diversified production of food and cash crops to meet the country's requirements for food, foreign exchange, increased rural incomes, and natural resources maintenance. To achieve these objectives the GOM places considerable emphasis on agricultural research. The research is organized by commodity groups. Each commodity research team is responsible for identifying the production constraints for its respective crops and then offering appropriate solutions.

The production constraints vary from one area of the country to another and with the nature of crops or livestock species. However, it is generally understood that smallholder production in Malawi is limited by low soil fertility, small land holdings, seasonal labor scarcity, paucity of production credit, and lack of improved farm tools and equipment.

The following section respond to the above-stated question for each of the five commodity groups. A more detailed discussion, including comments and suggestions related to the NRCUs, is provided in Annex J, "Impact of MARE Project on NCRUs."

C3a. The Cereals NRCU

Maize, rice, sorghum, millet, wheat, and barley are included in this NRCU. Maize is, however, considered the country's most important food crop, and it receives the most attention. The MARE project has trained or is funding the long-term training of six individuals from the maize program and four more from the rice program. The MARE project thus had a significant impact on the research capabilities of this NRCU.

The initial breeding and selection work was limited to improving the dent varieties. However, it was realized that the smallholder farmers were not adopting these varieties because of undesirable processing and storage characteristics. This led to intensified efforts to identify germplasm of flint varieties, an effort that soon paid off. By crossing the dent hybrids MH12 and MH16 with the flint population Posta Rica 8432, two new flint hybrids, labeled as MH17 and MH18, were obtained. These two high-yielding varieties have the flint characteristics of the local Malawi varieties and appear to be acceptable to farmers.

These varieties were approved by the Variety Release Committee, and the National Seed Company of Malawi (NSCM) multiplied enough seeds for distribution during the 1991/92 growing season. In the 1992/93 season, it is projected that over 1,200 tons of MH17 and MH18 will be available in ADMARC stores, enough to plant 70,000 hectares. NSCM markets seeds both privately and through ADMARC. In 1991/92, it supplied 6,200 metric tons of improved and hybrid maize seeds to ADMARC. This was a significant increase over the 5,000 metric tons supplied the year before.

The MH17 and MH18 flint hybrids, were recommended for release in September 1990, and the seeds were made available for planting in November for the 1991/92 crop cycle. This is a remarkable achievement by any standard. The MARE project contributed to the development of these varieties.

C3b. The Grain Legumes NRCU

The food grain legumes program engages in research, technology development, and exchange activities to improve the production and productivity of soybeans, pigeon peas, cowpeas, phaseolus beans, groundnuts, chickpeas, lentils, bambara nuts, fava beans, and other minor food legumes. Research on phaseolus beans and bambara nuts is carried out by Bunda College of Agriculture in cooperation with DAR and several international organizations. Research on other above-mentioned legumes is conducted by the DAR scientists based at Chitedze in collaboration with the various ARTs and such international research centers such as ICRISAT, IITA, AVRDC, ICARDA and INTSOY.

The MARE project did not give any direct technical assistance to the Grain Legumes NRCU, although some long- and short-term training was provided. The project also helped strengthen the rhizobium production unit at the Chitedze station.

This NRCU is a large program involving many grain legumes. Besides the Chitedze and the Makoka research stations, research on certain crops is also carried out at the Bunda College of Agriculture, involving many other collaborators. Hundreds of introductions are screened and tested annually at these localities. For phaseolus beans alone, an average of some 500 new introductions are screened every year.

Several of the food legume varieties and technologies developed on the stations were tested on the farmers' fields by various ARTs. The link between the phaseolus research group located at the Bunda College and the ARTs is almost non-existent.

C3c. The Livestock NRCU

About 80 percent of smallholder farmers own livestock, and the contribution to farm income is estimated at 36 percent during the dry season and 44 percent during the wet season. The major constraints to livestock production in Malawi are poor nutrition and management, the low genetic potential of the local breed, and inadequate disease and parasite control. Hence, the primary research focus of this NRCU is to improve livestock nutrition and management and their genetic potential through breeding programs.

Like the two NRCUs described above, MARE did not provide direct technical assistance to this NRCU. However, the project provided long-term training to two participants from this unit at the M.Sc. level and short-term training to several other staff members. MARE thus has upgraded the research capabilities of this particular unit.

For the past several years, this unit has been testing the adaptiveness and productivity of several lines of Cynodon, Guineagrass, Napiergrass, and Rhodesgrass and also some leguminous species.

This unit, in collaboration with the Agroforestry CRT and the ARTs, tested a few forage species on farmers' fields. It utilized the services of the Lilongwe ART socioeconomist to analyze socioeconomic data.

C3d. The Engineering & Land Husbandry NRCU, Agroforestry CRT (ACRT)

Agroforestry research activities have laid a sound foundation for a significant impact on agricultural sustainability and food security in Malawi. Management recommendations have been developed for several key technologies. These are now undergoing on-farm testing and pilot extension efforts in different ecozones of the country. The following paragraphs provide a brief description of some of these technologies.

Alley Cropping. Research in Malawi has shown that maize yields can be maintained at 2 to 3.5 tons per hectare under alley cropping with *Leucaena* on nutrient-poor or depleted

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soils in the absence of inorganic fertilizers. This technology seems to provide better than half the recommended rates of nitrogen for the production of maize. In phosphorus-deficient soils, the addition of 40 kg of P_2O_5 per hectare every other year can further boost yields, for example from 3 tons to 5.5 tons per hectare. Thus, this technology could substantially reduce the application rates of costly imported inorganic fertilizers and also attain substantial yield increases, especially with hybrid maize. *Leucaena* is, however, susceptible to termites and browsing during establishment. Therefore, other species such as *Cassia spectabilis* and *Gliricidia sepium* are being tested for their suitability as replacements for *Leucaena*.

***Acacia Albida* (or *Faidherbia Albida*).** These are fast-growing leguminous trees indigenous to Africa. The distinctive feature of these trees is that they grow and produce a lot of leaves during the dry season and then shed them at the beginning of the rainy season. Thus, the crops planted under these trees at the onset of rains are not affected by their shade. On the contrary, they provide shade and fodder when most other trees have no leaves. ACRT research has established that the yield of local maize grown under these trees, which is a common practice with the Malawian farmers, could be maintained at 2 to 3 tons per hectare. Supplemental feeding trials using the trees' pods showed significant weight gains in young sheep during the dry season. These findings confirm the value that the Malawian farmers attach to these trees.

Fodder Banks. These are generally small plots of high-yielding plants with nutrient-rich foliage and/or pods that could be used as supplemental livestock feed. They also yield a considerable amount of fuelwood and stakes or poles. *Leucaena* alone or intercropped with alleys of napier grass are currently being recommended.

Contour Grass Strips and Hedgerows. Cultivation of hillsides often leads to serious soil erosion and water run-off problems. Grass strips planted on the contour, along with suitable hedges of leguminous or fruit trees, often alleviate these problems. *Cassia* and *Gliricidia* are the shrubs recommended for this purpose. Vetiver grass and Napier grass also have shown promise.

Multi-Purpose Trees (MPTs). Systematic and scattered planting of MPTs on farms, homesteads, and boundaries can generate important sources of food, fodder, shelter, fuelwood, poles, and income. The program has compiled a list of useful trees that smallholders farmers could consider planting.

For all practical purposes, the agroforestry work in Malawi began with the initiation of MARE project, led by the capable long-term MARE agroforestry TA. Therefore, most of the Agroforestry CRT's accomplishments can be directly attributed to the MARE project.

The ACRT has collected a total of 163 species, accessions, or provenances of trees. Germplasm collected in Malawi include 67 indigenous species/provenances and 33 that are exotic or naturalized. All these species are presently at various stages of screening. A total of 22 species are being tested on-farm, including Vetiver and Napier grass. A further 21 species are now recommended as fast-growing MPTs in the annual *Guide to Agricultural Production*.

Research-based management practices have been developed for alley cropping, interplanting trees with crops, boundary and homestead planting, live fencing, fodder banks, and contour strips. Agroforestry technologies suitable for smallholders' use will be published in the 1992/93 *Guide to Agricultural Production*. Various GOM agencies, donor organizations, and NGOs are utilizing the team's recommendations with farm communities. In addition, the ACRT is providing them with planting materials and advice on an as-needed basis.

Concerning the team's impact on the smallholder agricultural production, the dissemination of agroforestry technologies has just begun and will show significant impact at the household level within a few years. It is our understanding that monitoring and evaluation of these impacts will be an integral part of the proposed USAID Agroforestry Extension Activity under the Agricultural Sector Assistance Program. Agroforestry technologies have been evaluated economically for smallholder farmers. This includes alley cropping maize with *leucaena*. These results have shown significant positive benefits over traditional cropping practices. The results of these analyses are available (see Hayes 1992).

C3e. The Horticultural NRCU

This program includes research on fruit crops, tree nut crops, vegetables, root and tuber crops, and spice and herb crops. Malawi offers a variety of agroclimatic conditions where many of these crops could be grown for profit. The crops are of high value in terms of nutrition and income generation potential for smallholders.

Research on all the above commodities is conducted at the Bvumbwe Agricultural Research Station near Blantyre. The evaluation team found the scientists at that station motivated and enthusiastic. The station has excellent research facilities and well-qualified researchers and staff. It is our understanding, however, that the station is not productive to its full potential because of a lack of operational funds. Policy makers seem to lack appreciation for horticultural crops. This limits reaching farmers through extension, as well as accessing ARTs.

MARE provided one long-term TA position for six years, served by one expatriate advisor for 2.5 years and another for 3.5 years. These two advisors made significant contributions to the entire horticultural research program. They carried out the research activities of Malawians who were in training in the U.S. They established contacts with other organizations for training and the importation of plant materials of citrus, pecans, coffee, and apples. The TAs conducted many short courses and provided on-the-job training for the station staff. The impact was most strongly felt in the areas of data management and analysis, word processing, and graphics.

The program benefitted a great deal from both long- and short-term overseas training of many of the researchers. Two individuals received Ph.D. degrees, two participants received M.Sc. degrees, and four others received certificate-level training. In addition, short-term consultants worked on coffee berry disease and Panama disease in bananas. Recommendations the consultants made are now being implemented.

The project purchased computers and software and equipped the laboratory with many essential items. The library has been expanded, and a new irrigation system has been ordered. The project funded the establishment of a horticultural genetic resource bank that has over 150 mango varieties, 20 avocado varieties, 10 local chili varieties, and all the banana and plantain varieties found in Malawi that have been identified and characterized. This has laid the foundation for horticultural breeding programs in Malawi to support its crop diversification policy.

Several fruit and vegetable crop varieties were selected for on-farm testing. However, since the ARTs were overwhelmed with the on-farm trials of cereals and other food crops, they were unable to accommodate any requests from the horticulture NRCU. Another problem is that the ARTs do not have horticulturists on the teams. However, the horticultural scientists, in collaboration with the ADDs and the farmers, conducted many on-farm trials themselves.

Improved varieties of mango, banana, pineapple, pawpaw, casimiroa, edulis, guava, avocado pear, citrus, apple, plum, pear, and strawberry have been released to growers. The growers have also received recommended production practices based on research-proven data, including pest management, plant nutrition, plant population, method and time of pruning, and soil moisture conservation measures. Furthermore, local collections of mango and banana were made. The list of all the recommended varieties has been included in Annex J.

Implementation of on-farm trials and demonstration plots has been incorporated in all horticultural commodities. The demonstration trials initiated at extension training centers and on farmers' fields at numerous sites resulted in improved linkages with the extension staff. This researcher-extension and staff-farmer interaction has led to increased production of mango, citrus, and avocado by smallholders in the Liwonde ADD; of cabbage, tomato, apple, and peach in Blantyre and Lilongwe ADDs; and indigenous vegetables in the Ngabu ADD (see Braunworth, "End-of-Tour Report").

Limited market surveys and analyses have been conducted to identify farmer problems and cost of marketing for banana and tomato. Based on this, a framework for data collection has been developed which can be adapted to other perishable fruit and vegetable crops (see Braunworth, "End-of-Tour Report"). Future research intends to focus on assessing and reducing postharvest losses and enhancing those crops' marketability. A project proposal to this effect has been developed under SADCC's umbrella and submitted to the donor community for funding consideration.

The two major constraints to farmer adoption of improved horticultural practices are a lack of knowledge of inputs and of marketing and a lack of improved planting materials. Where researchers distributed planting materials and technical advice, the farmers' response have been very positive. The constraints appear to be in the system itself. Horticultural crops in Malawi are viewed as a low priority and hence suffer from a lack of interest from policy makers and extension service personnel.

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MARE made a substantial contribution to smallholder horticultural production. (See Braunworth, "End-of-Tour Report"). For instance, an integrated approach to coffee berry disease control utilizing cultural practices, resistant varieties, and fungicides was developed. This will allow smallholders to maintain a cash income from coffee production. Intercropping trials of maize and beans with coffee were designed and initiated in Bvumbwe. These prototype trials will be the basis for developing a cash crop along with a food crop. There were also intercropping trials of cassava with maize and sweet potatoes with maize. This is aimed at developing recommendations for smallholder food security during droughts.

The Horticultural NRCU has illustrated the nutritional and income potential of several fruit and vegetable crops (see Annex J). It showed smallholders could supplement their incomes by MK 1,300, MK 212, or Mk 439 from only 20 trees of mango, tangerine, or peach, respectively. In just a few months time, vegetables can provide gross incomes ranging from MK 7,480 to MK 40,590 per hectare, which is well above input costs. The gross value of cassava and sweet potatoes per hectare is close to MK 6,000. In addition to monetary income, the nutritional values of these crops to smallholder families needs to be emphasized.

C4. Adaptive Research Teams (ARTs)

Are the adaptive research teams (ARTs) actively testing technologies developed by the National Research Crop Unit (NRCU) commodity teams to identify socially and economically appropriate technologies for smallholder farming systems?

The Adaptive Research Program (ARP) has been evolving since it began in 1983. Early farming systems research, supported by several donors and the GOM, set the stage for the expansion of the adaptive research approach within the MOA in 1985/1986.

The expansion effort, given direct impetus by the MARE project, linked smallholders, research stations, and MOA field staff. It was designed to focus research programs on farmers' priority problems, to develop specific localized recommendations compatible with farmers' circumstances and needs, and to improve the transfer of research results by strengthening linkages between research and extension personnel (see USAID/Malawi, 1985).

C4a. Establishment of Adaptive Research Teams

ARP professional staff were to include a national level Adaptive Research Program Coordination Unit (ARPCU) located at Chitedze and ARTs deployed at the ADD level, each to be composed of one agronomist and one socioeconomist.

Prior to MARE, ARTs were active in three of the eight ADDs, Lilongwe, Kasungu, and Blantyre. There was an independent program, supported by the German foreign aid agency GTZ, operating in Liwonde ADD. ARTs were deployed to the Karonga ADD around 1987 and to the Mzuzu and Salima ADDs in 1988/89, and activities in the Liwonde ADD were integrated within the ARP during this time. While plans to establish an ART in

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Ngabu are evident in the records, this has yet to be accomplished. Thus, ARTs have been established in seven of the eight targeted ADDs.

However, records indicate the ARTs in these ADDs have not been fully staffed. During the four-year period between mid-1986 and mid-1990, project documentation shows a majority of the ARTs were operating with only one professional officer (Tinsley, 1991). This was primarily due to ten of the ART-identified staff undertaking two-year M.Sc. study leaves.

Currently, in the seven ADDs, about two-thirds of ART professional posts are filled (see Annex K, "Adaptive Research Program Professional Staff"). This low staffing pattern is due to very high staff attrition rates, particularly for the socioeconomists. These rates appear to be caused by concerns with MOA's overall conditions of service, perceived lack of career advancement opportunities within the ARP, competing career opportunities, and possibly low morale stemming from problems in ARP implementation.

C4b. Consolidation of ARTs

Early in the ARP, it was recognized that a prerequisite to its smooth operation and success was regular cooperation and interaction with component parts of the MOA, as well as with farm families (Nyirenda, 1986). The following subsections highlight the extent to which ARTs have been consolidated within the system.

C4b(1). Consolidation among ARTs

Project documents record that the seven ARTs did meet consistently to discuss plans, progress, and problems (Tinsley, 1991). Among the teams, there seems to have been questions about the role of the socioeconomists. Overtime, as contributions of the socioeconomists became more apparent—partially through provision of diagnostic survey information upon which to prioritize on-farm agronomic research—their role has been somewhat clarified.

C4b(2). Consolidation within MOA

A constraint was identified early that seems to have influenced ART consolidation within the MOA structure. In 1986, it was noted: "The team has two masters. It is under CARO financially and professionally. It is under the Programme Manager administratively. Hence it has been difficult sometimes to sort out problems that relate three components, i.e., finance, profession, and administration." (Mwafulirwa, 1986, p. 155). This pattern continues today and appears to have had a significant impact on the relationships between ARTs, CRTs, and ADDs as discussed further below.

A critical problem related to ART/MOA consolidation centers on the inability of the system to respond, in a timely manner, to ART research-based recommendations. Discussion suggests there are cases where ART work resulted in regional-specific

recommendations. However, mechanisms for taking those recommendations and formalizing them for dissemination apparently do not function well and require further attention.

C4b(3). Consolidation at ADD Level

Discussions indicate there have been strong and useful collaborative working relationships between ARTs and senior extension members, including SMSs, in ADDs. The extent to which collaboration is formalized and whether working with ART is viewed as a specific work responsibility is not clear. There are examples of significant collaboration with the Women's Program staff, such as participation in field surveys and in annual meetings. However, there are few women heads of household participating in on-farm trials. Continued attention to increasing this collaboration is likely to strengthen the research effort to the benefit of smallholder farmers.

At the ADD level, ARTs are generally viewed as having made important contributions. There is no question that localized recommendations are needed at the ADD level. ARTs are the ADDs' only current source of localized recommendations. The ART socioeconomic survey work and subsequent on-farm trials focused on identifying, clarifying, and responding to local farmer-priority problems.

Discussions suggest that, at this level, ARTs have had a positive impact on the linkages between farmers, research, and extension. Extension needs location-specific recommendations. It is essential that there be a mechanism for their development. Extension, as a critical stakeholder, must be able to influence the research agenda. To further distance extension from this capability is likely to create an array of problems.

The involvement of FAs and farm home assistants (FHAs) as survey enumerators and/or implementers of field trials continues to be discussed. Their involvement must be a perceived and actual complement to their extension education responsibilities and not evolve simply as more work for them.

C4b(4). Consolidation with National Research Crop Unit (NRCU) Commodity Research Teams (CRT)

The least consolidation has occurred between the commodity research programs and the adaptive research program. The weakest links in the technology generation, transfer, and utilization are between these programs. The links are fragile and tenuous and represent a major issue in and challenge to the overall effectiveness of the system. The problem was documented as early as 1986 in the opening speech by the Controller of Agricultural Services (NRDP) at a research and extension workshop.

He lamented the fact that the role of adaptive research teams and commodity teams had been misunderstood and noted that problem-oriented research programs could be developed through adaptive research teams with maximum support of all those concerned. Commodity research should have a strong base and strong connection with adaptive research teams, he said. He also appealed to the participants to "clarify the misunderstandings since

adaptive research was being given high priority by the ministry." ("Proceedings of 1986 Research and Extension Workshop," p. 5.)

The current situation remains much the same, although there are specific instances of close collaboration. In particular, the interaction among those working on maize has been put forward as helpful, definite, and useful. This may be viewed in light of the comment: "Draft documentation of ART previously reported field trials shows that about two-thirds of trials involved maize in intercropping, fertilizer, and or variety trials. The large majority of the remaining one-third of trials focused on crops in the legumes/oilseeds and fibers area." (drafts of adaptive research proposed action plans 1992/93 to 1996/97.)

Still, basic problems with ART and CRT collaboration remain. Based on review of available documentation and discussion, several factors have been identified that are likely to have severely constrained collaboration. Detailed in Annex L, "Factors Influencing ART/CRT Collaboration," they include: lack of professional incentive to support collaboration, compounded by differing channels of authority; lack of logistical support and transport for collaborative efforts; differing research orientations and methodologies; and lack of at-post ART professional staff.

These factors result in the system not functioning as expected. Such bottlenecks must be addressed. A central problem is that the agronomic research role and methodology of ARP remain contentious subjects. Although the controller issued a clarifying directive in 1986 (see Annex M, "Methodology and Role of Adaptive Research Program"), questions remain regarding who can or should be engaged in which type of biologically focused on-farm research. Questions concerning the role of socioeconomists also remain, despite the existence of project documentation on their role in a systematic process for identifying farmer constraints, prioritizing researchable problems, and focusing on-farm trials.

There are an array of workshops and annual meetings in which ARP and NRCU staff are to plan joint research projects. These mechanisms do not appear to be working effectively and are apparently not sufficient for successful collaborative research efforts.

The extent to which NRCUs are producing technologies for on-farm testing by ARP is less often questioned. An inventory of these technologies would provide considerable and worthwhile insight. Unanswered questions include: On which criterion are technologies judged to be "ready" for adaptive research? At what stage in the technology development process should adaptive research be engaged?

C4c. Trials and Technologies

In light of these constraints, ARTs made important contributions to technology adaptation. While focused largely on aspects of maize (including dent and flint hybrids, composites, and local), ARP on-farm trials dealt with additional crops. These included: rice, bean (phaseolus), cotton, wheat, European potato, pigeonpea, cowpea, chickpea, and sunflower. Intercropping trials, a research contribution made largely by ARTs and

specifically reflecting farmer concerns, were conducted with maize/pigeon peas, cassava/maize, maize/soybean, maize/bean (phaseolus), and maize/pigeonpeas/cowpeas.

Rate and/or time of fertilizer application (high and low analysis fertilizer) trials were conducted with various of the above crops. Variety trials on most of the above crops were also conducted. Pest control and plant spacing trials were carried out, as were undersowing pasture legumes into maize and maize grown on old tobacco/groundnut ridges.

In adaptive research, a critical concern is who actually manages trials. Adaptive research must have an orientation toward and the flexibility to devote considerable attention to farmer-managed trials. For various reasons, most ARP trials conducted were far more researcher managed than farmer managed (see Annex M). This represents an important problem in the ARP's agronomic research methodology.

C4d. Dissemination of Technologies

Substantial ARP effort has focused on localizing fertilizer recommendations for maize. It is emphasized repeatedly that farmers tend to use less fertilizer than recommended in the *Guide to Agricultural Production*. Discussions indicate that some ARP research has shown that under specific agro-climatic conditions, a lower application rate than that officially recommended would result in very similar yields. In some cases, extension has noticed and utilized these results. However, an effective mechanism for official screening of ARP recommendations (excluding varieties) is clearly lacking. The research findings seem to disappear in the system.

This has not been the case with varieties. A system for releasing varieties is in place. ARP research contributed to the release of a Fusarium wilt-resistant variety of pigeonpea (ICP/9145) through this system. Their work on rice varieties contributed to the release of Senga (IET4094) and Changu (IR1 561-250-2-2). Yet, releasing varieties is a very lengthy process which may take up to eight years (Swanson, et al, 1986).

ARP research has contributed to the identification of many farmer problems, as well as to movement toward solving them. For example, ARP socioeconomic research was instrumental in further clarifying farmer preference for flint hybrid maize. This provided additional impetus to increasing research efforts on the flint hybrids and to the release of these varieties.

C4e. Conclusions

It is clear ARP has sharply focused attention on the need for and difficulty of obtaining regionalized recommendations. It is also clear ARP has substantially improved the system's ability to collect and analyze data on farm-level constraints. The continued need for adaptive research is not being questioned. There is widespread agreement it is essential. Now the challenge is to mold an overall system within which adaptive research is fully integrated and functioning effectively. This should receive priority. It may be appropriate to commission a study to investigate the role of adaptive research in the context of the overall

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system. It could explore ways to orient the system's research on the adaptability of technologies, to complement the emphasis on yield-increasing technologies and to offer practical alternative strategies for improving the adaptive research function.

C5. Extension Institutions

Have extension institutions been modified to be more effective in transferring technologies to greater numbers of smallholders?

In order to expand the reach of extension to a broader farming clientele in a cost-effective manner, extension has increasingly focused on group and mass media methods. This has occurred through the organization of farmer clubs (the basis for issuing seasonal credit), through organization of other specialized clubs, and through increased use of mass communications. The current block system is oriented toward extending extension advice and service beyond farmer clubs and specialized groups, to all smallholders.

An important aspect of the MARE project was to strengthen communication support and extend coverage of the smallholder population. The Extension Aids Branch headquarters and Mzuzu ADD were the locus of these efforts.

The EAB, located at the national level, is a branch of the DAET and includes an Evaluation and Action Research Section. EAB is linked to the ADDs through Visual Aids Units. VAUs have a staffing level of eight. The large majority of VAU staff hold certificates or are not degree holders (see Annex N, "Visual Aids Unit Staff and Qualifications"). The visual aids officers, trained at the diploma level and located at the ADDs, are the primary link between the national-level EAB and the ADDs.

C5a. Improvements in Agricultural Communications Services

Through provision of training opportunities,[6] facilities, and equipment (including for photography, graphics, radio, printing, and video and computer hardware and software, particularly desktop publishing), the capacity of EAB and the VAUs has increased, and the timeliness of their output has improved. This is particularly so at the national level although equipment is located at both levels. Various factors produce this increase, and the MARE project has made a significant contribution. Overall, both the quality and speed of delivery of publications and other communications has been greatly enhanced. Salient examples of this are discussed below.

A system has been formalized for the development, production, and dissemination of the annual *Guide to Agricultural Production*. This document, produced by EAB, is the official government statement of recommended agricultural practices. Approximately 7,500 copies are printed annually. A copy is provided to every FA and FHA in the country, as well as to other users. The EAB is experimenting with packaging of the guide using three-

[6]Eleven staff completed off-shore short-term training (in areas ranging from video and radio production to publications management) and one a long-term off-shore M.Sc. agricultural communications program.

ring binders so it may be more readily and inexpensively updated as new information is received.

Training in desktop publishing has enabled EAB to provide, on a more timely and regularized basis, the release of the bi-monthly "ZaAchikumbi" magazine sent to farmers throughout the country. An average of 192,000 copies are produced yearly.

The time and expense to produce cine films has decreased significantly through provision of video equipment and training. Video has been used in very innovative ways to recreate field experiences and bring the experiences and information to the ADD. This is a striking alternative for enhancing the flow of information from the farm level to the ADD level.

The yellow mobile media vans are a distinct extension "calling card." They are well known and well received in rural areas. They are attended by about equal numbers of men and women. Over the period 1985-1991, there were about 3,000 shows, with a cumulative total adult audience of about 3,750,000. Efforts to decentralize their operation will increase the visibility, and, some FAs and FHAs say, the credibility of extension in outlying areas. Via the Pilot Communications Project, about 25 FAs have received in-service training to increase the educational effectiveness of yellow van cine and puppet shows.

C5b. MOA Agricultural Communications Strategy

The basic agricultural communications strategy of the MOA is the expansion of the PCP to all ADDs. The strategy is multimedia, interactive, and farm based. It has high potential for addressing farmer-extension-research linkages and concerns. The strategy and its implementation have been recently discussed at a seminar convened by EAB in March 1992 and attended by DAR, DAET, and ADD decision makers.

C5c. Evaluation and Action Research Section

Two of the three professional staff in this section participated in training. One completed off-shore M.Sc. degree training in agricultural communications. The other completed short-term off-shore training focused on data analysis. The section has also been upgraded through installation of computing equipment and provision of data analysis packages.

C5d. Materials Production System

The production system is in place and functioning effectively. Output at EAB and ADDs has increased due to staff training, equipment procurement, and sound management of the system. While some equipment needs remain, primary needs have been met.

In addition to the substantial materials production discussed above, EAB produces an array of other communications materials ranging from radio programs to posters (see Annex O, "Extension Aids Branch Materials Production"). Furthermore, EAB has effectively

solicited and obtained private sector agricultural business and industry support for its communications efforts. Specific examples include underwriting of "ZaAchibumbi" by the local branch of a major agricultural firm, revenues of MK10,000 per year from commercials shown by yellow vans, underwriting of printing of selected four-color posters, and local support for radio programs.

Materials are also produced at the ADD level with the aim of distributing materials down to the section level. Discussions suggest this distribution has been severely minimized due to a lack of funds for paper and other consumables. This constraint is indeed hard to justify given the cost of paper and the critical need for communications among ADDs, RDPs, extension planning areas (EPAs), and sections.

C5e. Communications Support to Women's Activities

Films, brochures, pamphlets, posters, magazine articles, and extension messages directed specifically toward and/or including women have been developed over the life of the project. A notable example is the video project on the women's broiler production demonstration.

Women are also represented in print media. For instance, a count of the photographs in the May-June 1992 issue of "ZaAchikumbi" shows there are four pictures of women, four pictures of men, and six pictures of men and women together.

As with other SMS, women program officers (WPOs) at ADDs participate in various communications activities. In Mzuzu, some women staff have been involved in extension message development. It was noted in some baseline communications studies that the reported data was not gender disaggregated. While the original data was disaggregated, the importance of reporting disaggregated data is herein highlighted.

C5f. Pilot Communications Project (PCP)

The PCP aims at enhancing the existing organizational structure to promote better two-way communication among researchers, extension workers, and smallholders, so as to increase the productivity, quality of life, and incomes of farmers.

The project is framed conceptually by the infusion/diffusion process. It is an interactive process that stresses dialogue with farmers and directly addresses the issue of increasing farmer involvement in research and extension activities. There have been important impacts during its pilot phase as tested in four EPAs in Mzuzu, at each step in the overall process.

C5f(1). Infusion

Infusion is essentially an information-seeking activity. Due to the introduction of the framework, extension staff, particularly FAs and FHAs, have had increased contact with farmers. The importance of this interaction cannot be overemphasized. A very positive

impact of the infusion process appears to be a reorientation away from "chalk and talk" interaction with farm families toward a more interactive mode of communication. At the same time, FAs and FHAs have systematically obtained information on farmers' ideas about their needs, resources, practices, productivity, and extension communications. This has been accomplished through dialogue, four surveys, various case studies, and numerous discussions following yellow van cine presentations.

C5f(2). Message Development

The PCP concentrated on providing FAs and FHAs with appropriate messages to use during their training sessions with farmers at block meetings and block demonstrations. This was a highly successful component of the PCP. It was facilitated through establishment of a task committee at the Mzuzu ADD and through introduction of "presentation plans."

The task committee integrated technical and educational information with research-based knowledge of field conditions from infusion, to produce quality extension messages. Its existence focused attention on communication priorities. The committee was instrumental in the development of presentation plans.

Presentation plans are teaching tools. They are utilized by SMSs at their fortnightly training of FAs and FHAs and subsequently by FAs and FHAs in their training sessions with farmers. Various presentation plans have been developed that incorporate available localized technical subject matter with guidelines on how to effectively deliver the message. For an example of such a plan, see Annex P, "Mzuzu ADD Presentation Plan - Acacia Albida."

Presentation plans are one of the very few teaching aids available to FAs and FHAs. As such, they represent an important MARE contribution. All discussions suggest presentation plans have been very well received. FA and FHAs who participated in PCP presentation plan training say the plans helped them make their presentations more interesting. They thought this helped increase attendance at their meetings. Additionally, discussion with EAB staff suggests that the quality of the messages has been distinctly improved.

Providing at least one copy of a presentation plan to each FA and FHA has not been possible due to the lack of paper. Currently, SMSs delivering fortnightly training are the only ones who receive a copy.

C5f(3). Message Delivery

A summative evaluation of the PCP is underway, with Evaluation and Action Research Unit staff currently in the field collecting data. Additional information on message delivery is being collected. Careful consideration of this study will contribute to understanding the message delivery process, as well as to the overall impact of the PCP.

The critical issue with message delivery is delivering the messenger. Project documentation stresses the fact that field level mobility is continually listed as the biggest single communications problem.

C5f(4). Feedback/Evaluation

A system was developed for pretesting messages, refining them, and evaluating their impact. The summative evaluation, currently underway, will be an important documentation of results. A formative evaluation of the PCP project conducted in 1988 shows significant trends. (Hussein, 1989).

Via PCP presentation plans, four new varieties were recommended for planting during 1988-89 season. These were R201, R215, NSCM41, and Kalahari. Data was collected on farmers receiving the recommendations, correctly recalling the information, and correctly using the information. Results show about two-thirds of all farmers interviewed said they received information on at least one of the recommendations for varieties. Of these, about two-thirds correctly recalled at least one of the recommended varieties. Of these, about one-half used at least one of the varieties. There were statistically significant differences between club members and non-club members. Twice as many club members received the recommendation for varieties than did non-club members. Three times more club members than non-club members recalled it correctly. About six times more club members than non-club members used it correctly.

Extension messages are presented at meetings. Club members are the persons who most frequently attend meetings. The above data suggests extension messages are effective when they are received. It suggests the PCP process can have a positive effect on the adoption of extension recommendations. These findings demonstrate one of the most important impacts of the PCP project.

C5g. Conclusions

The PCP represents an opportunity that should be exploited. The evidence indicates PCP can improve the quality of extension messages, can be effective in in-service training of field level extension staff, and can influence farmer adoption of extension recommendations. The project was tested in a very small area. As it is replicated, differing constraints and opportunities are likely to arise based on differences in geography, culture, and economies in the areas of expansion.

In order to realize the benefits of the pilot project, resources are needed for its replication. The summative evaluation currently underway details these needs. They include in-service training of ADD level staff, support and rewards for those whose involvement is necessary for the success of an expanded project, and consumables.

C6. Women's Program

Has the Women's Program been strengthened it its ability to increase women's participation in agricultural research, extension and credit programs?

During the six years of support from the MARE project, MOA has made great progress integrating women farmers and professionals into the ongoing programs of extension, credit, and training. As an effective agent in this process, the Women's Program has been active in reshaping policy, delivering a series of income-generation projects, and training both male and female extension workers in skills for productive work with women farmers.

The MOA has been particularly successful in increasing the number of women farmers who receive credit through farmers' groups. In 1982-83, only 8.3 percent of such credit went to women. In 1985-86, the first year of the project, women received 19.4 percent, and by 1990-91, they received 34.4 percent.

The ability of the Women's Program to support participation of women farmers in shaping the research agenda has been more problematic, and, with the difficulties of most adaptive research teams, has virtually disappeared. Since women perform up to 70 percent of the farm labor and also make many of the production, processing, and storage decisions, their lack of voice in the research process remains a serious concern.

The scope of work identifies three major areas for evaluation of the Women's Program section: policy development and implementation, delivery of services and impact on women farmers, and strengthening the institutional capacity of the program. Each will be discussed in turn.

C6a. Policy Development and Implementation

During the eleven years of its existence, the Women's Program has progressed steadily in developing, disseminating and refining policies to improve rural women's access to productive resources. The program was established in 1981 to broaden the emphasis of the earlier Farm Home Economics Section, by placing increased emphasis on women's roles in agricultural production. Over time, the scope of the program has been broadened to include promotion of agriculture and agro-based income-generating activities.

Currently, the program targets all women farmers with the following three policy statements:

- To increase women's participation in extension programs and services in order to optimize adoption and agricultural productivity

- To increase household income through income-generating activities related to agriculture or agro-business

- To improve home and farm management skills and utilize available resources to improve family health and well being (MOA/WPS, 1989, p. 5)

Given the size and importance of the female farming population, these are ambitious goals, particularly for a relatively small, undertrained and understaffed unit. To implement them, a dual strategy is used. Some services are mainstreamed through the regular extension channels, and direct delivery of others goes on through the Women's Program staff. For this strategy to work effectively, both the goals themselves and the methods for achieving them must be made clear to a wide range of actors. Progress has been steady although much remains to be done.

In 1987, the goals were amplified into a three-year plan of action. An implementation manual containing practical strategies to increase women's access to credit, inputs, and information was developed and disseminated to the MOA and ADDs. In 1988, DOA revised its extension policy guidelines to pay particular attention to the inclusion of women farmers. By 1990, when the MOA's five-year extension plan was developed and disseminated, specific percentage goals were included for women's participation in credit programs, farmer groups, and the like. Through strong support from the MOA, execution and monitoring of such a strategy has proved feasible.

A further marker of policy integration is the inclusion of a section on the Women's Program in the annual *Guide to Agricultural Production* from 1989 onwards. Both the five-year plan and the guides also make frequent reference to the need to include women farmers within in the technical sections of the documents.

C6b. Delivery of Services and Impact on Women Farmers

The best indicators of policy implementation are changes in the gender patterns of resource flows, particularly at the local levels. Because access to credit is through membership in farmer groups and relatively few women were in these groups at the beginning of the program, a dual strategy has been pursued. Wherever possible, women are encouraged to join gender-integrated groups. Where this possibility is limited, women-only groups are formed, both by the male FAs and the female FHAs. Both types of groups are to receive the same types of extension advice, input supply, and marketing advice. However, not all farmer clubs receive credit.

The following tables, adapting information from the Women's Program Section (1991) and Culler (1990), depict women's participation in credit clubs:

MIXED CLUBS

Years	No. of Clubs	Women Members	Women Receiving Credit
1984-85	7,801	22,450	20,651
1988-89	9,103	55,597	53,226

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WOMEN-ONLY CLUBS

Years	No. of Clubs	Women Members	Women Receiving Credit
1984-85	478	11,999	2,359
1988-89	1,076	28,086	22,098

According to the Women's Program Section, by 1990 there were 1,594 female extension clubs, with an average membership of 25. Of these, 928 were organized by male FAs. That indicates slightly more than half the FAs have organized a women's extension group, in addition to working with women in the integrated groups. The goal of the five-year plan is for each FA to have at least one women's group by 1995 and for each FHA to have four. This goal seems possible in light of current achievements.

Because there is a general perception that farmer groups reach slightly more affluent households, there is a second program of credit and extension directed to more resource-poor women farmers. These are the group demonstrations of income-generating activities (IGAs). Within the country, there are 941 women's groups engaged in IGAs. Of these, the Women's Program provides technical support to 74 demonstration groups funded through MARE and ten funded through UNDP/FAO.

The demonstrations provide credit and technical assistance to already existing women's groups for two years. During this period, the group is to select an agriculturally based activity and jointly produce for market. After two years, either they continue as a group or move to individual production, utilizing their new technical skills and knowledge of credit and marketing. Most groups have chosen production of crops, including both traditional and hybrid maize, vegetables, beans, groundnut, soybean, sweet potato, cotton, and rice. Livestock was also chosen in a number of cases, including poultry, pigs, fish, goats, and stall-fed cattle. In large part, the regional cropping patterns dictated the crop and livestock selections.

These demonstration groups have been problematic for a number of reasons. Moving the MARE demonstration funds through the system proved agonizingly slow, and for some time funds were stopped entirely. A new system of disbursement has been agreed upon to correct this problem and should be put in place promptly.

A more substantive problem, according to a study commissioned by MARE, is that many IGAs have not in fact generated income for their members. This was due to problems with input supply, marketing, inadequate land, and inadequate technical assistance (Balakrishnan, 1991). A number of recommendations for improving the program are included in that report, including identification of a limited number of economically viable activities and then training of both Women's Program staff and other SMSs within the ADDs in the extension of such activities. The five-year extension plan goal for IGAs also states "group IGAs should yield a profit of at least MK25/member/season; individual IGAs should yield a profit of at least MK50/season."

Profitability is often a problem with such small IGAs for women, particularly if they are executed by an agency which is not accustomed to thinking in such terms. In the economic analysis of promising activities, such as stall feeding of cattle, it is most useful to demonstrate the profitability of new technologies before they are introduced, to minimize risk to low-resource farmers. Assistance could be sought from commodity research teams, such as horticulture and agroforestry, that are anxious to demonstrate promising technologies. Solar drying of tomatoes, vegetables, banana chips, and fruits may be particularly useful to explore with horticulture.

To show their benefits to poorer farmers, demonstration plots of the new flint hybrids would also be useful as they come on line. The flints have the added advantage of relatively easy local access to inputs and marketing through ADMARC, if the IGA groups can graduate into regular farmer group status. Additional work with the processing technologies for these new flints should also be investigated, to see whether there may be income-generation opportunities for women. Such links would also provide commodity researchers with useful feedback on the constraints women farmers face.

In all cases, profitability and marketing issues must be carefully addressed in the demonstrations if they are not to be pointless. Working with the IGA demonstrations is very labor intensive for Women's Program staff, as well as women farmers. The whole exercise only makes sense if it is viewed as a way of addressing women's income needs and at the same time tightening the links between women farmers and the agricultural technology development and transfer system.

C6c. Strengthening Institutional Capability of the Women's Program

From its inception, the Women's Program has been understaffed, underresourced and undertrained. Some progress has been made under MARE, but the statement remains true today. Both the Women's Program policy guidelines and the five-year extension strategy plan call for major increases in staffing. Current lack of such staff constrains the program. At administrative and SMS levels there are substantial gaps. No position exists for the section head of the Women's Program, and only five of the eight ADDs have an officer at the PO level. When ADD-level position vacancies are filled, many are by people with lower qualifications and insufficient training for permanent appointments. Although many of them are doing an excellent job, their pay is pegged at lower levels because of their qualifications rather than their responsibilities.

Under MARE funding, two members of the Women's Program staff have received overseas training at the masters level, and a number have been proposed for overseas training under other potential funding. A number of certificate holders have also been nominated for a fourth year of in-country training leading to a B.S. degree from Bunda College, which would qualify them for permanent appointment to some of the acting posts. One training document notes that although only 20 percent of the MARE overseas trainees are women, in the next proposed but apparently canceled training project, 60 percent would be female. One might ask why so many women landed at the end of the queue.

Short-term third-country training included two senior Women's Program members attending short courses in the U.S. and two in Swaziland on project planning. Ten staff members went on a study tour of income-generation projects in Kenya and Zambia. All have returned to post. Some in-country training was also provided, but the program had a great deal of difficulty in accessing the TOT training. This difficulty constrained training for the FHAs in the techniques being given to their FA colleagues.

At the field level, staffing and training levels are also constrained. At present there are only 257 FHAs in post for the entire country. The MOA five-year extension plan for 1990-1995 includes a commitment for a major staff expansion, which is essential. For the past five years, the Women's Program has been able to hire adequately trained graduates of the Natural Resources College (NRC), but because of the previous history of the office, many older FHAs were trained in a one-year school and are not trained in agriculture. With MARE funding, a yearlong agriculture course was developed for these women at the Natural Resources College, and two cohorts of 34 FHAs have gone through this program. More than half the first class graduated with distinction, and the second appears likely to repeat this record. Demand for two more courses has grown and would be useful. This would raise the proportion of adequately trained FHAs to sixty percent. As it stands, the proportion is closer to forty percent. This problem needs continuing attention, particularly since the staff is spread so thinly.

All NRC program graduates have returned or will soon return to their FHA posts. Although it is customary to receive a raise upon completion of training, the women have been told that they will not because they are not being promoted to a new grade upon return. Yet it is understood that the graduates of the other two refresher courses at NRC, in land survey and veterinarian assistantship, do receive such raises. For the sake of program morale, this needs to be checked, and if true, remedied.

C6d. Summary and Recommendations

Given the low resource base from which it operates, the Women's Program is doing an excellent job at the policy level and appears to be doing a reasonably good job at the field level. MARE funding for training, technical assistance, and field demonstrations has substantially strengthened the program, but much more remains to be done. The return of trainees strengthens both field and headquarters operations, but increased staff at or close to the levels in the five-year plan are necessary if the unit is to adequately perform its assigned duties. Completion of the proposed training of ADD and FHA staff at NRC and Bunda College is also very important, and a way to fund this training should be actively sought. With such training, staff will be in a better position to develop and execute useful demonstrations and to assist women farmers in increasing their income.

With the major policy issues related to credit and extension now clearly articulated and in the process of implementation, attention can now be turned to issues of linkage with other units, particularly those involved in setting research priorities. At present, the office has no links to the commodity research teams and no way to utilize their findings directly, let alone to influence their research priorities, or to input the specific constraints and concerns of

women farmers. Lack of attention to issues of commodity processing and storage seem to be a direct result of this gap. The reported unwillingness of earlier maize researchers to move from dent to flint hybrids is an example of the effects of such inattention. Attention to policies concerning women's access to cash crops, such as burley tobacco, is also very important. Some work has already been done by the program on both issues and should be continued. A policy study undertaken by Ariz-Nino provides a useful model for involvement of the office in policy dialogue at the ministry level.

SECTION III
OVERALL PROJECT IMPACT

Along with GOM and other donors, the MARE project has contributed to a viable research and extension system in Malawi. This system is already showing increased returns and will show much more, probably within the next two to five years.

The overall strengthening of the maize, agroforestry, and horticulture programs is already providing new materials and ideas to farmers. More site-specific research and on-farm evaluation of these technologies will help reduce the overall cost of national recommendations from the *Guide to Production* and identify new problem areas for future research. The Forestry Department is now providing *Acacia* seedlings to farmers. Increasingly, quantities of hybrid maize, chemical fertilizer, and credit are available to male and female smallholders.

There is an increasing recognition among public officials and agencies of the need to increase maize yields and overall land productivity while also reducing the requirements for chemical fertilizer. Research and extension personnel are becoming more confident of their ability to respond to the constraints of smallholder agriculture.

There have been significant improvements in the quality and timeliness of extension material diffused. Also there have been increases in the number of smallholder farmers reached in the MARE-supported extension Pilot Communications Program. There have been improvements in the teaching process as a result of the training of trainers program. The Women's Program reached increased numbers of farmers. Components of the research and extension system have been strengthened. However, they have yet to function as an integrated system giving adequate attention to the adaptability of technology.

The predecessor to the MARE Project had a large impact on the maize program. The present project has had some impact on the maize program and substantially contributed to strengthening the research and extension system in agroforestry, horticulture, and economic analysis.

The impact of the MARE project on the MOA's institutional capacity and personnel capabilities in agricultural research and extension has been favorable. Nonetheless, the salary structure and broader incentive system have precluded significant improvements in the institutional capacity and personnel capabilities of the agricultural research and extension departments of the MOA.

Training. At the simplest level, the impact of training on individual trainees should be evaluated. In a study of all three NRDP V staff training projects, 66 percent of the trainees ranked their U.S. education very relevant to Malawi's agricultural development objectives, and another 26 percent ranked it somewhat relevant. Short course respondents

also ranked relevance highly. A high proportion of respondents also indicated they were utilizing what they had learned on the job and that this utilization seemed to increase with the second position held. Since the professional life of MARE graduates back on the job is expected to be six to twenty years, this finding promises a positive long-term effect on the functioning of the ministry.

The in-country training of trainers program was targeted at the ability of the extension system to effectively communicate with farmers. Previous surveys of farmers had indicated they ranked the extension agents' technical knowledge and ability quite highly, but were somewhat less enthusiastic about their ability to deliver messages. The primary TOT purpose was to improve teaching and interaction skills of the extension system at all levels. Participants in this training consistently ranked its usefulness and relevance as very high. These newer training methods are percolating through the system and reaching farmers. Although there is no farmer impact study for the MARE project, the use of similar methods in Malawi by the World Bank, Rockefeller, and UNICEF indicate an on-farm gain in productivity when extension personnel use TOT principles to interact with smallholder farmers.

It is difficult to assess the long-term impact of such intensive and extensive training on the functioning of MOA, but it has been and will continue to be very great. Just before MARE began, the 1985 INTERPAKS study judged the MOA's technology generation and transfer system to be effective, well organized, and capable of learning from experience. In the ensuing seven years, the system has been profoundly perturbed by a series of donor interventions and outside shocks, in addition to the comings, goings, and post reassignments associated with the training process. It will take some time for the system to adjust to a new equilibrium, and the process will undoubtedly demand patience and good judgement on the part of all concerned.

In the face of serious personnel and funding constraints, the training unit is doing an outstanding job. The staff is energetic, well organized, and capable, and they have made intelligent use of the technical assistance provided through MARE.

Agricultural Research Council. AGREDAT has made a substantial contribution to research priority identification and planning. The scoring mechanisms currently employed are important to improve research resource allocation. Further work needs to consider all activities of the DAR and DOA, and within them, commodity program resource allocation decisions. The ARC needs to be a smaller body with regular attendance of the same personnel. Maintaining and improving the capacity of AGREDAT requires action now to retain trained staff.

National Commodity NRCUs. Five NRCUs are conducting research on economically viable smallholder technologies for priority traditional and nontraditional crops. The MARE project provided direct technical assistance to only two units, the Agroforestry CRT and the Horticultural NRCU. However, it did provide training to staff members from all five units. The training program substantially strengthened DAR's overall commodity

research capabilities. Nonetheless, the more significant impacts were in the two units where long-term TAs were assigned.

Several researchers from the cereals NRCU have been trained in the U.S. by the MARE project and also by its predecessor project. The dedication and hard work of these researchers, complemented by the ARP on-farm trials, led to the release of two flint-type maize hybrids, MH17 and MH18, in 1990. This is a remarkable achievement and will contribute to major increases in maize production over the next two to five years.

The MARE agroforestry TA has led in activities for laying a sound foundation for agricultural sustainability and food security in Malawi. Management recommendations have been developed and farm tested for several key technologies. Some of these recommendations will appear for the first time in the 1992/93 *Guide to Agricultural Production*. For all practical purposes, the agroforestry work in Malawi began with the MARE project. Therefore, the accomplishments in agroforestry described in this report are a direct result of MARE.

The two MARE horticultural TAs have made significant contributions to the entire horticultural research program. In addition to providing on-the-job training to Malawian researchers in many areas, they also actively participated in research, on-farm trials, and in surveys and marketing studies.

Adaptive Research Teams. The general opinion is that while adaptive research is an excellent concept and an essential component of technology development and diffusion, its application has not met expectations. Since inception of the project, ARTs have on average operated with one professional officer rather than the allocated two.

It is clear that ARP has sharply focused attention on the need for and difficulty of obtaining regionalized recommendations. It is also clear that ARP has substantially improved the system's ability to collect and analyze data on farm-level constraints. Now the challenge is to mold an overall system within which adaptive research is fully integrated and functioning effectively. It should assure that the adaptability of technologies complements the emphasis on yield increasing technologies.

Extension Institutions. There is a significant increase in the media production capacity of the Extension Aids Branch and Visual Aids Units stemming from the project's provision of training opportunities, facilities, and media equipment. Both the quality and speed of delivery of publications and other communications has been greatly enhanced. The EAB has reflected women's involvement in agricultural production in its communications outputs.

As its agricultural communications strategy, the MOA has adopted the concept and methodology developed and tested through the project-sponsored Pilot Communication Project. The PCP has demonstrated its systematic approach to agricultural communications can improve extension message quality, farmer-extension linkages, and field-level extension

staff training. Current evidence, to be reviewed in light of the summative evaluation, suggests the PCP process positively influences the adoption of extension recommendations.

Women's Programs. During the six years of support from the MARE project, the MOA has made great progress in integrating women farmers and professionals into the ongoing extension, credit and training programs. The Women's Program has reshaped policy, implemented income-generation projects, and trained both male and female extension workers in skills for more productive work with women farmers.

The MOA has been particularly successful in increasing the number of women farmers who receive credit through farmers groups. In 1982-83, only 8.3 percent of such credit was going to women. In 1985-86, the first year of the project, women were receiving 19.4 percent, and by 1990-91, they were receiving 34.4 percent, according to ministry figures.

The ability of the Women's Program to support women farmers in shaping the research agenda has been more problematic. With the difficulties of the ARTs, this influence has virtually disappeared. Since women provide up to 70 percent of the farm labor and make many of the production, processing, and storage decisions, their lack of voice in the research process remains a serious concern.

SECTION IV
UNEXPECTED OR UNPLANNED PROJECT IMPACTS

In terms of unplanned institutional impact, it was expected that the project, via the Adaptive Research Program, would contribute to an overall system delivering regionalized, more site-specific recommendations. Only limited progress was made in this regard, due in part to unexpected functional bottlenecks, such as the agronomic research role of the ARTs and the mechanism for formalizing, authorizing, and disseminating regionalized recommendations. Nonetheless, the project compelled the MOA to reassess its priorities vis-à-vis research, particularly on-farm research. The demand for regionalized recommendations has also increased and been more sharply focused. The increased demand for more site-specific recommendations was unplanned, but should not have been unexpected given the site-specific characteristics of agricultural production.

A MARE project management review process in addition to the one undertaken by the contractor was planned. That did not happen. Comments suggest that a quarterly or semi-annual review would have proven useful in tracking project progress and more quickly ameliorating problems.

The project was explicitly concerned with linkages. The PCP and the TOT addressed similar issues, yet plans for their systematic linkage were not developed as expected. This has implications for expanding the PCP and TOT, which can be addressed as they are further deployed at the ADDs.

Enthusiasm for PCP exists in Mzuzu, as well as in other ADDs. The impetus has been developed, yet the funding for continuing and/or expanding the effort is under question. One telling comment was that field staff feel they have been "orphaned." This is an unplanned impact but can still be addressed.

The unexpected loss of project-trained personnel with graduate level degrees, especially economists, is forcing the MOA to look at salary structure and incentives and consider reorganizing DAR as a semi-autonomous agency. Clearly, mechanisms must be developed to keep well-trained personnel in the ministry.

SECTION V
LESSONS LEARNED FROM PROJECT

Knowledgeable persons state the MARE project was relatively well designed, except for three things. One was a lack of attention to soil science in the system. Another was an overestimation of the number of existing technologies developed in the system that were ready to be extended to smallholders. A third was a greatly reduced support for the maize program.

The MARE project's predecessor made a substantial contribution to the maize program. The MARE project design included only modest support for the maize program, just at the time the program was in a position to start producing new technology. The reduced support seriously compromised the potential impact of the program. Fortunately in this case, the Rockefeller Foundation was able to fill the gap. There is a lesson here that is directly applicable to the agroforestry program and, to some degree, to the horticultural program as these programs are just now starting to produce technology.

A different system of USAID project management was tried, one without a chief of party. A U.S.-based project coordinator and the MOA controller of agricultural services (NRDP) were responsible for overall project management. The long-term TAs were fully integrated into the MOA structure. Most connected with the project believe the arrangement worked quite well.

Participant training was a well-conceived and important project component. A high percentage of project funding was spent for graduate level training for qualified personnel, with the idea the MOA's institutional capacity would be strengthened. Unfortunately, retaining trained personnel within the ministry has become a serious problem. This requires that the MOA look at its ability to retain qualified personnel and then take appropriate action. The GOM, with donor support, must take the lead in stopping personnel losses and leadership discontinuities. The potential adverse impact of the continued loss of the trained personnel responsible for production and diffusion of new technology is very great.

The funding of recurrent costs remains a major problem. Major infrastructure has been built, people have been trained, and laboratories have been equipped. Making available modest operating funds at this stage would go a long way towards building a high quality research and extension system. There has been a failure to provide even modest levels of operating funds for many key research and extension activities. Mechanisms must be found to provide this support.

The MARE project has compelled research and extension to reassess their priorities, particularly regarding on-farm research. The need for regionalized recommendations is clear. It was expected the project would contribute much to delivering more site-specific

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recommendations. Only limited progress was made, suggesting this process is more difficult than anticipated.

One of the project's objectives was to help diversify smallholders' production and income base. Generally speaking, this has not happened. Nevertheless, future income increases should come from the solid research programs in agroforestry and horticulture. The economic conditions for smallholders have been very difficult due to repeated droughts and structural reforms that reduced subsidies to farmers. The agroforestry and grain legumes research programs will help make use of technologies and management practices to reduce fertilizer requirements. Moreover, revising the research priorities would emphasize cassava and sorghum-millet more, thereby increasing the ability to withstand droughts. Substitution of maize by other crops, such as sorghum, sweet potato, cassava, and banana, should be encouraged.

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ANNEX A

LOGICAL FRAMEWORK FOR MARE PROJECT

LOGICAL FRAMEWORK
AGRICULTURAL RESEARCH AND EXTENSION

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
GOAL			
To increase incomes of smallholders.	Production levels of food crops, and other agricultural products. are higher resulting in improved incomes for small holders.	GOM statistics	Economic incentives for farmers are favorable
SUB-GOAL			
To strengthen domestic institutions to support smallholders.	Better quality support services are available to more smallholders.	GOM records Project evaluation	1) Agricultural institutions will provide technologies acceptable to farmers and a means for transferring them.
PURPOSE	**End of Project Status**		
To improve the MOA's institutional capacity to increase productivity of traditional crops and to identify the most viable crops for diversifying smallholder production.	1) Training Unit fully operational and undertaking training programs for research and extension staff	GOM records Project evaluation	GOM recurrent finances and personnel levels are maintained at least at the current levels in real terms during life of Project.
	2)Agricultural Research Council is specifying priorities for research and allocating funding according to these priorities.		Policy makers continue to support organizational changes in the MOA. IDA provides timely financing for its research & extension activity planned.
	3)Five Commodity Research NRCUs are undertaking research on priority traditional and non-traditional crops	GOM records Project evaluation Project records	Adequate numbers of qualified Malawians are available for training.
	4)Eight Adaptive Research Teams are established and capable of using technologies of the Commodity Teams	GOM records	The GOM is able to retain trained staff in position, for which they receive their training
	5)Extension institutions are modified to be more effective in transfering technologies to greater numbers of smallholders.	Project records Project evaluation	Continued MOA policy support for integrating research and extension activities. Requisite production inputs to support agricultural technologies are available on a timely basis.
	6)Womens Program is strengthened to increase womens participation in agricultural research, extension and training activities.	GOM records Project records Project Evaluation	IDA financing is provided as scheduled

OUTPUTS	MAGNITUDE OF OUTPUTS	EXPECTED LEVELS OF EFFORT	MEANS OF VERIFICATIONS	ASSUMPTIONS
1. MOA Staff Training Established	1 Training Unit staffed and functional	2 Staff trained to MSc level Annual Workplans developed Organizing the training of trainers	GOM records, Project Records Project Evaluation.	MOA provides counterpart personnel for the Training Unit
	1 Training Unit Advisory Committee established	2 meetings held per year	"	
	1 Cadre of trainers established	100 trainers trained to deliver in-service training program		
	Trained Personnel	49 staff trained to MSc and PhD levels, 49 staff receiving short term specialized training, 4,291 persons given in-service technical/management training from DAR, DOA, PD and other agricultural institutions	"	Qualified MOA staff are available for training
2. ARC system for evaluating and setting research priorities is developed	1 National Agricultural Economic and Data Processing Unit established	1 data bank established; economic/financial analyses conducted for each NRCU to determine feasibility of proposed research and to verify economic viability of results	"	ARC requires an economic analysis of research proposals before providing funding
3. Strengthened Commodity Research NRCUs conducting research on economically viable technologies for smallholders	1 Cereals NRCU research capability increased for maize	Improved maize varieties tested on station and adapted varieties passed on to ARTs for on-farm testing		

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OUTPUTS	MAGNITUDE OF OUTPUTS	EXPECTED LEVELS OF EFFORT	MEANS OF VERIFICATIONS	ASSUMPTIONS
	1 Grain Legumes NRCU been research upgraded	improved bean varieties tested on station and adapted varieties passed on to the ARTs for on farm testing		
	1 Livestock NRCU research upgraded in pastures work	On station researchs to select improved forage varieties On farm testing of adapted forage varieties		
	1 Agroforestry CRT established under the Engineering and Land Husbandry NRCU	On station screening of tree varieties. On farm testing of adaptive varieties by the ARTs		
	1 Horticultural NRCU expanded	On station research to continue selection of annual vegetable crops and on-farm testing of adaptible varieties by ARTs On station research to select adaptible fruit and nut trees		
	6 National Research Coordinating Units cooperating together on joint research projects	On farm testing of adapted technologies generated by ARTs	•	ARC continues to provide effective coordination of NRCU's
4. Expanded Adaptive Research Teams identifying technologiesvaich are socially and economically appropriate for smallholder farming systems	5 new AR teams established and 3 AR teams upgraded	15 AR staff trained to the MSc level	•	ART operations funds are provided by IDA
	8 ADDs supporting the ARTs to agroecologically test and adapt specific technical packages and practices	550 trials over the life of the project leading to 18 agroecological specific technical packages tested and verified by the ARTs by PACD	•	
	8 ADDs assign a senior extension member and a WPO to work part-time with ART members	50% of Senior Extension member's time allocated to AR activities; 40-50% of WPO's time allocated to AR activities	•	DDA/ADD's provide counterpart personnel to the ARTs

OUTPUTS	MAGNITUDE OF OUTPUTS	EXPECTED LEVELS OF EFFORT	MEANS OF VERIFICATIONS	ASSUMPTIONS
5. Improved Agricultural communications services delivering extension services to greater numbers of smallholders	1 MOA strategy developed for Agricultural communications	1 National communication-support plan produced per annum; 8 ADD level communication-support produced plans per annum	GOM Record, Contractor Records, Project Evaluation	
	1 Evaluation and Action Research Section upgraded	4 major evaluation studies and 16 smaller-studies		
	1 material production system for translating research, prices, input and information into extension messages and scheduling, producing and disseminating educational materials in various media	By PACD, production of a combined annual output of 200 radios programs, 20 bulletins, 25 handbook sheets, 6 bi-monthly magazine issues, 25 leaflets, 2 flip charts, 10 posters, 2 slide sets with scripts 6 audio presentations, and audio visual tapes		
	1 Agricultural Communications System supporting women's activities	20% of educational materials developed for smallholders will reflect women's involvement in agricultural production.		
	1 Mass Communications Pilot project in one ADD	1 Strategy tested and replicated in 8 RDPs		
6. Strengthened Women's Program Section for increasing women's participation in agricultural programs	1 Strengthened Women's Program Section	1 Women's activities policy modified to increase the participation of women in agricultural production		MOA continues to support increased women participation in its programs
	Staff skills improved to promote women's activities and women's involvement in agriculture	9 women program officers training in program planning and technical agricultural skills (also included in Training Component); 200 female extension staff trained to teach agricultural skills and topics to women farmers		
	Greater numbers of women smallholders are assisted by women specific activities through	1 agricultural production demonstration activity targeted towards women in every RDP by PACD		

ANNEX B

SCOPE OF WORK FOR MARE PROJECT FINAL EVALUATION

ANNEX B
SCOPE OF WORK FOR MARE PROJECT FINAL EVALUATION

A. ACTIVITY TO BE EVALUATED

The Malawi Agricultural Research and Extension (MARE) Project 612-0215 was authorized on July 18, 1985, with total funding of $14 million and a PACD of September 30, 1990. The PACD was subsequently extended to September 30, 1992, and life-of-project funding increased to $15 million. The project purpose is to improve the Malawi Ministry of Agriculture's institutional capacity to increase the productivity of traditional crops, and to identify the most viable crops for diversifying smallholder production.

B. PURPOSE OF THE EVALUATION

The primary purpose of the MARE Final Evaluation is to measure the degree to which the project goal, sub-goal and purpose level indicators and output targets, as contained in the Logical Framework, have been achieved. The final evaluation is also expected to identify and quantify any unexpected or unplanned project impacts, provide an explanation for any indicators or output targets which were not achieved (if any), and state what lessons can be learned from the MARE implementation experience.

C. BACKGROUND

The agricultural sector has traditionally been the primary engine of economic growth in Malawi, and the customary landholder (smallholder) subsector is especially important. Approximately 1.3 million smallholder families currently produce 85 percent of Malawi's basic food supply of maize, groundnuts, pulses, cassava, sorghum, millet and rice. However, most of these food crops are grown primarily for home consumption, with only small surpluses entering the domestic cash market. Smallholders also produce virtually all of Malawi's cotton, dark-fired, sun-air cured and oriental tobacco, and small amounts of tea, sugar, and coffee.

The MARE Project design recognized the major role of the smallholder agricultural subsector, and the need to improve agricultural production and productivity in the subsector as a contribution to Malawi's economic growth. The project was specifically designed to address the following constraints to the continued development of the smallholder subsector:

- distorted input and output price relationships;
- lack of available technologies suitable for smallholders;
- limited and untimely availability of fertilizer;
- lack of an effective research-extension linkage;
- high cost of agricultural service delivery;

- shortage of skilled agricultural personnel; and
- an extension cadre burdened with too many functions.

In response to these constraints, and in conjunction with an IDA financed program of support to the agricultural sector, MARE's purpose is to improve the Ministry of Agriculture's institutional capacity to increase the productivity of traditional crops, and to identify the most viable crops for diversifying smallholder production. The project contains three distinct components:

Training. The purpose of the training component was to establish and institutionalize a training system within the Ministry of Agriculture (MOA) to provide MOA staff with opportunities for upgrading their current skills and developing new skills. The project-funded MOA Training Unit is guided by the Training Advisory Committee, and utilizes a variety of long-term and short-term training to: (a) upgrade the technical skills of researchers and extension workers; (b) transfer adult education training methods to trainers; (c) improve Department of Agriculture (DOA) and Department of Agricultural Research (DAR) planning, administration, management and implementation skills; (d) strengthen the linkages required for effective technology transfer between the DOA and DAR at all levels; and (e) ensure that the mix of staff skills is appropriate for the MOA's smallholder development program, institutional structure and development priorities. The training component was expected to provide research personnel with the enhanced skills required for developing smallholder technologies, and to provide extension staff with improved abilities for disseminating appropriate agricultural technologies. It was also expected to serve as the principal mechanism for sharing information and expertise between and among the DAR, DOA, Planning Department (PD) and smallholder farmers.

Agricultural Research. The purpose of the agricultural research component was to assist the Department of Agricultural Research (DAR) in becoming more responsive to the production constraints faced by smallholder farmers. The research component was specifically intended to assist the DAR in generating appropriate technologies for improving the productivity of traditional crops, and in identifying new crops for diversifying smallholder production. Research activities under the project were focussed on increasing the returns to land and labor employed in the production of traditional crops (especially maize), and on identifying crops for diversifying smallholder production which can provide higher incomes, employment, and foreign exchange generation.

Assistance to the DAR to achieve these ends consisted of project support to: (a) develop an Agricultural Economics and Data Processing Unit (AGREDAT) to conduct economic, financial and statistical analyses of research results and proposals for use by the Agricultural Research Council in setting Malawi's research priorities; (b) strengthen five National Commodity Research Coordinating Units (Horticulture, Cereals, Grain Legumes, Livestock and Pastures, and Agricultural Engineering/Land Husbandry); and (c) develop an Adaptive Research Program, eventually consisting of a National Coordination Unit and eight Adaptive Research Teams at the Agricultural Development Division (ADD) level.

The research component was expected to produce relevant localized technology packages for dissemination to smallholder farmers through the extension program, and to be linked with training through the provision of technical and scientific information, and the participation of research personnel in the training program. Joint planning sessions by the DAR and the DOA to set research priorities were expected to be an integral part of the effort.

Extension. The purpose of the extension component was to strengthen agricultural extension in terms of institutional linkages with agricultural research, and the ability to disseminate research recommendations to smallholders. This was to be achieved by utilizing communication support to more effectively cover the smallholder population; responding to the specific needs of female smallholders; and linking extension efforts to applied adaptive research systems.

The Mass Communications and Women's Program activities funded under the project were seen as offering a significant potential for expanding the number of smallholders effectively served by the DOA, and for improving the effectiveness of extension staff in communicating and transferring improved agricultural technologies. The extension program was also expected to support research by actively participating in agricultural research programs, and by serving as the principal feedback mechanism for providing information from the farmer to the researcher. The extension component also supports the training component by providing training personnel, facilities, and developing training materials through the Extension Aids Branch of the MOA.

As previously stated, the MARE Project purpose is "to improve the MOA's institutional capacity to increase productivity of traditional crops and to identify the most viable crops for diversifying smallholder production." The indicators of purpose achievement were defined in the following End-of-Project Status statements in the MARE Logical Framework:

- Training Unit fully operational and undertaking training programs for research and extension staff.
- Agricultural Research Council specifying priorities for research and allocating funding according to these priorities.
- Five commodity specific National Research Coordinating Units (NRCUs) undertaking research on priority traditional and non-traditional crops.
- Eight Adaptive Research Teams established and capable of using technologies produced by the Commodity teams.
- Extension institutions modified to be more effective in transferring technologies to greater numbers of smallholders.

- Women's Program strengthened to increase women's participation in agricultural research, extension and training activities.

The principal contractor under the Project was the Consortium for International Development (CID), with Oregon State University serving as the project coordinator. CID's $8 million contract financed seven long-term advisors, fifty-five months of short-term assistance, training, and commodity procurement. Two USDA PASA advisors were also financed under the project. A total of 48 participants were sent to the United States for M.Sc. and Ph.D. level training, 45 of whom have returned to date.

A mid-term evaluation of the MARE Project was performed in early 1989. As a result of the evaluation team's findings and recommendations, the project PACD was extended from September 30, 1990, to September 30, 1992. The CID contract was extended through the same period, and three long-term advisors were eventually extended by one year, to permit an overlap of TA advisors with counterparts returning from overseas training. The project is currently in its last year of implementation, with the three remaining long-term advisors scheduled to depart during 1992.

D. STATEMENT OF WORK

Although MARE is generally described as an institution-building project, USAID/Malawi is particularly interested in determining what impact MARE had on smallholder farmers. Therefore, the purpose of the MARE Final Evaluation is to measure the project impact on smallholder agricultural production in Malawi.

The final evaluation team will concentrate on measuring the developmental impact of the project on smallholder agriculture by verifying the degree to which the project goal, sub-goal and purpose and output level indicators have been achieved, describing the principal reasons for the degree of achievement, explaining any shortfalls in expected end-of-project status, and noting any substantive project achievements which were not originally planned. The team is also expected to identify and quantify any unexpected or unplanned project impacts.

The final evaluation team will be expected to report on its findings, and provide an analysis of those findings leading to conclusions. Based upon those conclusions, the team is expected to identify and quantify overall project impact, and explain what lessons can be learned by AID from the MARE Project design and implementation experience. This information will be included in a Project Evaluation Summary, and in the Project Assistance Completion Report.

The contractor will undertake the work required to answer the questions outlined below with respect to expected end-of-project status at the goal, sub-goal, purpose and output level. Particular attention should be given to assessing the impact on smallholders, both individually and as a group, at each level. The evaluation team should also assess gender, geographical distribution, and crop variances at each level to further illuminate and explain the overall project impact.

The following questions will be used by the contractor to direct and focus efforts. The questions contained listed here represent the minimum degree of detail expected. The contractor may expand upon them to more fully document overall project impact.

D1. Goal

The project goal is to increase the incomes of smallholder farmers. With respect to the goal level indicators:

1. Has the total production of food crops and other agricultural products grown by smallholders increased as a result of MARE project activities? Specifically:

(a) For which smallholder-produced food crops and other agricultural products has total production and/or production per hectare increased over the life of the project?
(b) By how much has production of each crop increased?
(c) What proportion of the increase can be attributed to MARE?

2. Have smallholder incomes improved as a result of MARE project activities? Specifically:

(a) How much has per capita income in the smallholder sector increased during the life of the project?
(b) How much has food availability in the smallholder sector increased during the life of the project?
(c) What proportion of the increase can be attributed to MARE?

3. What has been the impact of MARE on smallholder farming practices? Specifically:

(a) What new technologies are smallholders adopting as a result of MARE efforts?
(b) What is the potential medium- and long-term effect of technology adoption?

D2. Sub-goal

The project sub-goal is to strengthen domestic institutions to support smallholders. With respect to the sub-goal level indicators:

1. Has the quality of support services available to smallholder farmers improved as a result of MARE? Specifically:

(a) What specific smallholder support services have improved in quality during the project?
(b) What specific quality improvements have been made?
(c) What part of the qualitative improvement can be attributed to the MARE project?

2. Are more smallholder farmers receiving support services as a result of MARE? Specifically:

(a) How much has the number of smallholder farmers receiving support services increased during the life of the project?

(b) How much of the increase can be attributed to the MARE project?

D3. Purpose

The project purpose is to improve the Ministry of Agriculture's (MOA) institutional capacity to increase the productivity of traditional crops, and to identify the most viable crops for diversifying smallholder production. Since there is a direct relationship between the purpose level indicators, and the magnitude of outputs as specified in the Project Logframe, the questions framed below regarding purpose level indicators include discrete questions related to the magnitude of outputs achieved. With respect to the purpose level indicators specified in the Logframe:

1. Is the MOA Training Unit fully operational and undertaking training programs for research and extension staff? Specifically:

(a) Is the Unit fully staffed with qualified professionals?

(b) Is the Training Unit functioning in an effective, sustainable manner?

(c) Are Training Unit staff turnover rates acceptable?

(d) Are Unit operating costs part of the MOA recurrent budget?

(e) Is the Training Unit Advisory Committee providing effective guidance and direction to the Training Unit?

(f) Has a cadre of trainers been established to deliver in-service training to research and extension staff?

(g) How many personnel have been trained as a result of the MARE project? Specifically:

(i) How many individuals have completed MSc and PhD training? In what disciplines?

(ii) How many individuals have received short-term specialized training? In what areas?

(iii) How many individuals have received in-service technical and management training as a result of project activities?

(iv) Where are these individuals (especially long-term trainees) working now, and what are they doing?

(h) What has been the impact of training on research and extension staff capability and performance?

(i) What factors, such as GOM salary levels, may constrain the overall impact of the training activities on research and extension? How can these factors best be mitigated by the GOM?

2. Is the Agricultural Research Council specifying priorities for research and allocating funding according to these priorities? Specifically:

(a) Is the National Agricultural Economic and Data Processing Unit (AGREDAT) fully staffed and functional?

(b) Are AGREDAT staff turnover rates acceptable?

(c) How effective is AGREDAT at identifying specific research priorities? What methodology is it utilizing to identify priorities? Is the methodology reinforced by budgetary allocations?

(d) Is the Agricultural Research Council using AGREDAT analyses as a basis for specifying research priorities? If so, how?

(e) Are current research funding allocations based upon priorities identified by AGREDAT? If so, which ones?

(f) What changes in research priorities and funding allocations can be directly attributed to AGREDAT?

(g) What has been the impact of changes in research priorities and funding allocations on MOA research programs? Smallholder farmers?

3. Are five National Commodity NRCUs conducting research on economically viable smallholder technologies for priority traditional and non-traditional crops? Specifically:

For the Cereals NRCU:

(a) How has the Cereals NRCU research capability for maize increased as a result of the project?

(b) How many improved maize varieties have been tested on station?

(c) How many adapted maize varieties have been passed on to Adaptive Research Teams (ARTs) for on-farm testing?

(d) How many new maize varieties have been released as a result of project activities?

(e) How long does it take for new varieties recommended for release to be released to farmers?

(g) What has been the impact on smallholder maize production of MARE supported maize research in aggregate terms and on per hectare yields?

(h) What has been the impact on smallholder incomes of MARE supported maize research?

(i) What have been the economic returns on the investment in maize research?

For the Grain Legumes NRCU:

(a) Has the quality of the Grain Legumes NRCU research been upgraded as a result of the project?

(b) How many improved bean varieties have been tested on station?

(c) How many adapted varieties have been passed on to the ARTs for on-farm testing?

(d) How many new bean varieties have been released as a result of project activities?

(e) What has been the impact on smallholder bean production of MARE supported grain legumes research?

(f) What has been the impact on smallholder incomes of MARE supported grain legumes research?

For the Livestock NRCU:

(a) Has the quality of Livestock NRCU pastures research been upgraded as a result of the project?
(b) How many improved forage varieties have been selected on station?
(c) How many adapted forage varieties have been farm tested?
(d) What has been the impact on smallholder utilization of improved forage varieties as a result of MARE funded pastures research?
(e) What has been the impact of pastures research on smallholder ruminant livestock production?
(f) What has been the impact of pastures research on smallholder incomes?

For the Engineering and Land Husbandry NRCU, Agroforestry CRT:

(a) How many tree varieties have been screened on station?
(b) How many adaptive tree varieties have been tested on-farm by ARTs?
(c) What agroforestry research results have been generated apart from variety screening and testing?
(d) What has been the impact on smallholder utilization of agroforestry techniques as a result of project activities?
(e) What has been the impact on smallholder agricultural production of the agroforestry research carried out under the MARE project?
(f) How do the labor requirements of crop production utilizing agroforestry techniques compare to labor requirements when agroforestry is not utilized?
(g) What are the differences in gross and net income between agroforestry and traditional crop production techniques?
(h) What has been the impact on smallholder incomes of MARE supported agroforestry research?

For the Horticultural NRCU:

(a) What impact has the MARE project had on horticultural research?
(b) Which annual vegetable crops and varieties have been selected from on-station research for on-farm testing by ARTs?
(c) Which fruit and nut trees have been selected as adaptable varieties as a result of on-station research?
(d) What is the current status of on-farm testing of vegetable and tree crop varieties identified from on-station research?
(e) Are marketing issues being addressed by horticultural researchers for perishable crops?
(f) What are the major constraints to farmer adoption of improved horticultural practices?

(g) What has been the impact on smallholder agricultural production of the horticulture research carried out under the MARE project?

(h) What has been the impact on smallholder incomes of MARE supported horticultural research?

4. Are the Adaptive Research Teams (ARTs) actively testing technologies developed by the NRCU commodity teams to identify socially and economically appropriate technologies for smallholder farming systems? Specifically:

(a) Have expanded Adaptive Research Teams (ARTs) been fully established and consolidated in each of the eight ADDs?

(b) Have each of the 8 ADD's assigned a senior extension member and a Women's Program Officer to work part-time with ARTs members?

(c) Are the NRCUs cooperating on joint research projects and producing adaptive technologies for on-farm testing by ARTs?

(d) Are all 8 ADDs actively supporting agroecological testing and adaption of specific technical packages and practices?

(e) How many trials have been carried out by ARTs during the life of the project?

(f) How many agroecological specific technical packages have been tested and verified by the ARTS during the life of the project?

(g) How many of these specific technical packages have been broadly disseminated to smallholder farmers?

(h) What has been the impact of ARTs activities on smallholder adaption of new technologies during the project?

(i) What has been the impact of ARTs activities on smallholder crop production during the life of the project?

(j) What has been the impact on smallholder incomes of ARTs activities?

(k) Are GOM budgetary allocations for ARTS activities consistent with their impact on smallholders?

5. Have extension institutions been modified to be more effective in transferring technologies to greater numbers of smallholders? Specifically:

(a) Have agricultural communications services been improved as a result of the project?

(b) Has the MOA developed an agricultural communications strategy? If so, what is it?

(c) How has the MOA Evaluation and Action Research Section been upgraded?

(d) Is a material production system in place for translating research, prices, input and information into extension messages?

(e) Is the material production system (Extension Aids Branch) scheduling, producing and disseminating educational materials in various media?

(f) During the life of the project how many radio programs, bulletins, handbook sheets, bi-monthly magazine issues, leaflets, flip charts, posters, slide sets with scripts, audio presentations, and audio visual tapes have the Extension Aids Branch produced?

(g) Is the agricultural communications system supporting women's activities? How?

(h) What percentage of educational materials developed for smallholders reflect women's involvement in agricultural production?

(i) What has been the impact of the Mass communications Pilot Project? How have the results been tested? How are they being replicated?

(j) What has been the impact on technology adaption by smallholders of the improved agricultural communications system?

(k) Has the number of smallholders reached by extension services increased as a result of improved communications? By how much?

(l) What has been the impact on smallholder agricultural production of the communications activities supported by the MARE Project?

(m) What has been the impact on smallholder income of the MARE agricultural communications activities?

6. Has the Women's Program been strengthened to increase women's participation in agricultural research, extension and training activities? Specifically:

(a) How has the Women's Program Section been strengthened to increase women's participation in agricultural programs?

(b) How have women's activities policies been modified to increase the participation of women in agricultural production?

(c) If policies have been modified, how effectively are they being implemented? If policies have not been modified, what are the constraints?

(d) How have MOA staff skills been improved to promote women's activities and women's involvement in agriculture? Specifically:

(i) How many woman program officers have been trained in program planning and technical agricultural skills under the MARE project?

(ii) How many female extension staff have been trained to teach agricultural skills and topics to woman farmers under the MARE project?

(iii) Where are woman program officers and female extension staff trained under the MARE project currently working, and what are they doing?

(e) How many RDPs have targeted a specific agricultural production demonstration activity towards women as a result of the MARE project?

(f) Has the number of women smallholders assisted by women specific activities increased as a result of the project? By how much?

(g) What has been the effect of women specific activities on female smallholder decision-making roles?

(h) Is the amount and timing of funding to women's groups for their activities adequate to meet their needs?

(i) Have GOM rules and regulations constrained the effectiveness of women's income generating activities under the project? If so, how?

(j) What has been the impact on smallholder agricultural production of Women's Program activities funded under the MARE project?

(k) What has been the impact on smallholder income and nutrition of Women's Program activities funded under the MARE project?

D4. Unplanned Impacts

During project implementation there are invariably impacts which were not originally intended, both positive and negative. Therefore, to the extent they can be identified:

1. What unplanned institutional impacts were produced as a result of the MARE project? Specifically:

(a) What unplanned positive impacts resulted from MARE project implementation?
(b) What unplanned negative impacts resulted from MARE project implementation?
(c) What was the effect on overall project impact of these unplanned impacts?

2. What unplanned impacts on smallholder agricultural production resulted from MARE supported activities?

(a) What unplanned positive impacts resulted from MARE project implementation?
(b) What unplanned negative impacts resulted from MARE project implementation?
(c) What was the overall effect on project implementation and results of these unplanned impacts?

D5. Overall Project Impact

Based upon the information gathered with respect to the questions cited in A through D above, and an analysis of the information, what has been the overall impact of the MARE project on the following:

1. Ministry of Agriculture institutional capacity and personnel capability in agricultural research? agricultural extension?

2. Ministry of Agriculture dissemination of improved agricultural technology, and adaptation by smallholders?

3. Smallholder cropping patterns and overall agricultural production?

4. Smallholder family incomes?

D6. Lessons Learned

Using the information gathered by the evaluation team with respect to project impact as the basis for analysis, what lessons can be learned from the MARE project experience? Specifically:

1. What lessons can be learned about agricultural project design from the MARE project?

2. What lessons can be learned about agricultural project implementation from the MARE project?

3. What lessons can be learned about effectively managing agricultural projects from the MARE project?

E. METHODS AND PROCEDURES

The methods utilized by the evaluation team will depend upon the availability of specific data, and the efforts required for the team to gather the information needed to answer the questions posed in Section 4. The evaluation team is expected to review MARE Project reports and documentation, interview GOM counterparts, returned participants, CID/OSU staff and technical advisors, and USAID staff. The team is also expected to conduct site visits to interview MOA extension staff and smallholder farmers in those areas where major project activities have been carried out. The geographic spread of MOA staff and smallholders interviewed, and the gender of each, is expected to be representative of the geographic and gender distribution of MARE funded activities. The number of smallholders to be interviewed, and the geographic distribution of interviews, will be agreed upon by USAID/Malawi in response to the contractor's proposal.

Information will be available to the evaluation team from the following sources:

USAID. USAID/Malawi will provide the contractor and/or team leader with the following documents in advance of the team's departure for Malawi, if feasible: (1) Project Paper; (2) Project Agreement and Amendments; (3) full set of Project Implementation Letters (PILs); (4) full set of Project Implementation Reports (PIRs); and (5) Mid-term Evaluation Report and Mid-term Project Evaluation Summary (PES). The evaluation team will also have access to the MARE project files as part of their data base. Other substantive reports and documents related to project implementation will also be supplied to provide the evaluation team with sufficient background information. The evaluation team will receive direction and assistance from a Senior FSN employee in the Agriculture and Food Security (AFS) Office, who has assisted with MARE project implementation for the past five years.

Ministry of Agriculture. The Ministry of Agriculture (MOA) will provide one full-time counterpart to work with and assist the evaluation team. The evaluation team will have access to MOA project documents, and to MOA staff, both central office and field, who have been involved in project implementation for interviews.

Consortium for International Development (CID). CID was the primary technical assistance contractor under the MARE project. Three of the CID long-term advisors will still be in country during the period of the evaluation, and will be available to meet with evaluation team members regarding their work. In addition, the CID Coordinator, Dr. David Acker of Oregon State University, has agreed to be in Malawi prior to the arrival of

the evaluation team. Dr. Acker will assist in gathering relevant documentation for review by the team, and will remain in Malawi during the first three weeks the team is in country to assist the evaluation team in planning, scheduling, and to provide background information to orient the evaluation effort. CID will also be evaluating the Pilot Communications Effort, beginning in March and continuing through May. The final evaluation is expected to overlap with this effort, and evaluation team members will be able to interview the CID team evaluating the Pilot Communications Effort.

The final evaluation field work is expected to be carried out over a five-week period beginning in May 1992. A total of 130 person/days of effort is anticipated in Malawi. The team leader is expected to: arrive in Malawi one week prior to the other evaluation members to meet with MOA counterparts, USAID staff and CID contractors; make logistical plans; and, prepare for the arrival of other team members.

Evaluation team members will be authorized six-day work-weeks. The team leader is expected to spend a total of 5 work-weeks in Malawi, and the other team members 4 work-weeks each. The team leader and one other team member (the agricultural economist) will be authorized an additional work-week in the United States to prepare the final evaluation report.

The final evaluation will include travel of team members throughout Malawi. Visits to the Bvumbwe Research Station outside of Blantyre, where horticultural research is taking place, as well as Chitedze Research Station outside of Lilongwe, where the agroforestry research work is headquartered, will be required. Site visits to areas where agroforestry and women's program activities are being implemented will also be required.

The contractor will be responsible for all logistical support arrangements for the final evaluation team. USAID/Malawi will not provide office space, secretarial support, computer services or transport. The names of local firms which are available to provide secretarial and administrative support services will be provided upon request. Rental vehicles, though somewhat expensive, are readily available. The team should ensure that computer equipment is equipped with surge protectors, transformers, adaptors and cables required to use Malawi's 3-point, British type, 240V electrical system.

F. EVALUATION TEAM COMPOSITION

The final evaluation team will consist of five persons, to be provided by the contractor. The specific qualifications and work requirements for each individual are detailed as follows:

Team Leader. The team leader will be primarily responsible for planning and managing the entire evaluation process, and for preparation of the final evaluation report. Prior experience as the team leader for an AID Project final evaluation is required. The team leader should be an experienced agricultural professional, with a minimum of an M.S. Degree in agricultural economics or one of the agronomic sciences. A Ph.D. Degree is preferred. He/she should have a minimum of fifteen years of field experience in adaptive

research and extension efforts and/or farming systems research, with a minimum of ten years overseas experience, preferably in Africa. Estimated six work-weeks of effort.

Agricultural Economist. This individual will be primarily responsible for quantifying the impact of the MARE Project on smallholder agricultural production and income. A minimum of an M.S. Degree in Agricultural Economics, with an emphasis on Production Economics, is required. A Ph.D. Degree is preferred. The Agricultural Economist should have at least fifteen years of practical experience in production economics, with at least ten years of overseas experience. At least a portion of that experience should as a university researcher or extension specialist responsible for research and extension planning and execution. Prior evaluation experience is required, and prior experience in quantifying the economic impact of agricultural research and/or extension efforts in other countries is desirable. Estimated five work-weeks of effort.

Agricultural Extension/Communications Specialist. This individual will be primarily responsible for evaluating the effectiveness and impact of communications techniques and extension efforts supported under the MARE Project. A minimum of an M.S. degree in Extension Education or Agricultural Communications is required. The individual should have a minimum of ten years of broad practical experience with the use of print, video, group and radio techniques for disseminating information, particularly with respect to agricultural technologies. He/she should also be familiar with techniques utilized to reach target populations which have been previously overlooked. In the Malawi context this means women-headed households and the smallest of subsistence farmers. Prior overseas experience in agricultural extension and/or communications is required. Estimated four work-weeks of effort.

WID/Training Specialist. This individual will be primarily responsible for evaluating the impact of activities carried out by the Women's Program Section under the MARE Project. He/she will also be responsible for evaluating the impact of MARE funded training activities, particularly off-shore academic training, on the MOA's institutional capabilities. The individual will also be responsible for evaluating the impact of local in-service training activities on project goal and purpose. A minimum of a M.S. or M.A. in agricultural economics, sociology or anthropology is required. A Ph.D. level degree is preferred. The individual should have a minimum of ten years of experience with WID and training activities in the agricultural/rural sector. Prior overseas experience is preferred. Estimated four work-weeks of effort.

Agronomic Research Specialist. This individual will be primarily responsible for evaluating the impact of MARE Project activities carried out by the five National Commodity NRCUs (Subjects include cereals, grain legumes, pastures, agroforestry, and horticulture). A Ph.D. degree in agronomy, forestry or horticulture is required. The individual should have a minimum of fifteen years of experience in planning, managing and carrying out agricultural research activities, with particular emphasis on the areas cited above. At least five years of overseas experience is required, and prior experience with agroforestry research is desirable. Broad prior experience in the evaluation of agricultural research impact is preferred. Estimated four work-weeks of effort.

G. REPORTING REQUIREMENTS

The team leader will be required to provide the USAID/Malawi Agriculture and Food Security (AFS) Office with a list of planned interviews by the end of his/her seventh day in Malawi. The team leader also be responsible for briefing MOA and USAID staff on the progress to date of the evaluation team at the beginning of the team's third week in Malawi. The exact date for the debriefing will be determined in consultation with the team leader upon his/her arrival in Malawi.

The team leader will be responsible for debriefing MOA and USAID staff on the final evaluation findings prior to departure from Malawi. The team leader will be responsible for providing AFS staff with a working copy of the draft final evaluation report 3 working days prior to the final debriefing.

The team leader will be responsible for providing USAID and the MOA with 5 copies of the draft final evaluation report prior to the team's departure from Malawi. USAID and MOA staff will review the draft report, and provide the contractor with written comments for incorporation into the final evaluation report within three weeks of receipt of the draft report.

The final evaluation report will consist of the following elements:

- **Executive Summary.** The Executive Summary should state the development objectives of the activity evaluated; purpose of the evaluation; study method; findings; conclusions; and lessons learned regarding project design and implementation. The executive summary should not exceed eight pages in length.

- **Project Identification Data Sheet.** A blank copy of the Project Identification Data Sheet will be provided to the evaluation team upon request.

- **Table of Contents.**

- **Body of the Report** The body of the report will include a discussion of (1) the purpose and study questions of the evaluation; (2) the economic, political, and social context of the project; (3) team composition and study methods (one page maximum); (4) evidence/findings of the evaluation team concerning the study questions; (5) conclusions drawn from the findings, stated succinctly; and (6) lessons learned from the evaluation. The body of the report should not exceed 40 pages in length. Other detailed discussions of study methodology and technical topics may be included as annexes to the final report.

- **Appendices.** The following appendixes to the Final Evaluation Report are required: (1) Evaluation Scope of Work; (2) Project Logical Framework; and (3) List of documents consulted, and individuals and agencies contacted. Brief discussions of study methodology and technical topics may be included as additional appendixes.

The contractor will submit 10 copies of the final evaluation report to USAID/Malawi no later than 30 days after receipt of written Mission and MOA comments.

The contractor will also be responsible for completion of the abstract and narrative sections of the AID Project Evaluation Summary Form. The completed sections of the AID Project Evaluation Summary Form will be submitted under separate cover, and are not to be included in the Final Evaluation Report. Blank copies of the AID Project Evaluation Summary Form will be made available to the contractor upon request.

ANNEX C

DOCUMENTS PUBLISHED BY MARE PROJECT

ANNEX C
LIST OF DOCUMENTS PUBLISHED BY MARE PROJECT

Project Publication Number	Title
11[1]	Proceedings of the Induction Workshop for National Rural Development Program Technical Assistance Personnel - November 1986
12	Semi-Annual Technical Report - April 1987
13	Workplans of Consortium for International Development Technical Personnel - April 1987
14	Semi-Annual Technical Report - October 1987
15	Proposed Evaluation System for CID Technical Assistance in the MARE Project October 1987
16	Short-term Consultant Report: (Cooper) Microcomputer Systems Development and Training - December 1987
17	Short-term Consultant Report: (Dontoh-Russell) Income Generating Activities Training for Women's Program Officers - January 1988
18	Short-term Consultant Report: (Sensenig) Proposed Design - Mzuzu Pilot Communication Project - January 1988
19	Workplans of Consortium for International Development Technical Assistance Personnel 1988-89 - April 1988
20	Semi-Annual Technical Report - April 1988
21	Short-term Consultant Report: (McNamara) Desktop Publishing and Microcomputer Training - June 1988
22	Semi-Annual Technical Report: October 1988

[1]Number 11 is the first publication in the MARE Project publication series.

23	Short-term Consultant Report: (Day) Pilot Communication Project - November 1988
24	Short-term Consultant Report: (Shock) Video Electronic Field Production - November 1988
25	Short-term Consultant Report: (Shane) Pilot Communication Project - April 1989
26	Semi-Annual Technical Report - April 1989
27	Workplans of Consortium for International Development Technical Assistance Personnel 1989-90 April 1989
28	Short-term Consultant Report: (Shenk/Cooper) Weed Management Short Course - 1989
29	Short-term Consultant Report: (Cooper) Extension Aids Branch Microcomputer Assistance - April 1989
30	Semi-Annual Technical Report - October 1989
31	Short-term Consultant Report: (Bassman) Agroforestry - April 1989
32	Short-term Consultant Report: (Podmore) Small Farm Irrigation - October 1989
33	Short-term Consultant Report: (Hussein) Communication Evaluation Project - October 1989
34	Workplans of Consortium for International Development Technical Assistance Personnel 1990-91 April 1990
35	Semi-Annual Technical Report - April 1990
36	Final Report - R. William
37	Final Report - T.G. Gillard-Byers
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41	Short-term Consultant Report: (Javed) Coffee Berry Disease Assessment in Malawi and Proposals for Its Control
42	Final Report - D. Hilleman
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45	Short-term Consultant Report: (Hilleman) Extension Aids Branch Analysis of Current Needs and Future Requirements
46	Short-term Consultant Report: (Ploetz) Banana Production Constraints in Malawi: Results of a Survey Conducted in June,1990
47	Short-term Consultant Report: (Morford) Scientific Editor
48	Semi-Annual Technical Report - April 1991
49	Annual Work Plans - April 1991
50	Short-term Consultant Report: (Acker) Agroforestry Technology Transfer Planning - August 1991
51	Short-term Consultant Report: (Ott) Desktop Publishing - September 1991
52	Short-term Consultant Report: (Balakrishnan) Income Generating Activities Analysis - September 1991
53	Semi-Annual Technical Report - October 1991
54	Short-term Consultant Report: (Roberts) Transport Management - November 1991
55	Inventory Handing Over List - October 1991
56	Short-term Consultant Report: (Debons) Scientific Writing - December 1992
57	Short-term Consultant Report: (Riley) Gender Analysis of Curriculum - March 1992

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60	Short-term Consultant Report: (Giltrow) Agroforestry Extension Training - July 1992 (forthcoming)
61	Short-term Consultant Report: (Giltrow) Summative Evaluation of Pilot Communication Project - 1992 (forthcoming)
62	Short-term Consultant Report: Women's Access to Agriculture Extension Service - 1992 (forthcoming)

ANNEX D

REPORTS AND DOCUMENTS REVIEWED BY EVALUATION TEAM

ANNEX D
REPORTS AND DOCUMENTS REVIEWED BY EVALUATION TEAM

Ahmed, Mohamed M.	*The Impacts of the Introduction of a New Sorghum Hybrid in the Gezira Scheme of Sudan*, Unpublished Paper, February 1992.
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ANNEX E

INDIVIDUALS CONTACTED BY EVALUATION TEAM

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INDIVIDUALS CONTACTED BY EVALUATION TEAM

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ANNEX F

AGRICULTURAL TECHNOLOGY DEVELOPMENT IN MALAWI

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AGRICULTURAL TECHNOLOGY DEVELOPMENT IN MALAWI

The returns of agricultural research in both developed and developing countries have repeatedly been shown as very high (Ruttan 1982; Echeverria 1990). Facilitating the development of national research organizations and integrating them with international research centers and with developed country researchers are critical institutional activities in the development process. The payoff is the production of new technologies for farmers and the creation of the capacity to respond to emerging agricultural problems.[1] One successful innovation in a new cultivar, for example, frequently has such high benefits to society that it pays for all the activities of the research institution over some period.

Technology development is the application of scientific principles or concepts to resolve constraints to increasing output. One fundamental characteristic of agricultural production is the site-specific requirements of agriculture innovation. New technologies have to be regionally tested and adapted to fit into different climatic, edaphic (soil), disease and insect regimes, farming systems, and consumer preference niches. Since these are multiple requirements, it is rare that new technologies will satisfy all the requirements. Rather technology development is a continual evolutionary process. As new problems are identified, researchers continually seek to improve upon their earlier contribution. Crop and preference shifts also go on among farmers and consumers as farming systems evolve and tastes change.[2]

The application and diffusion of science to agriculture can be divided into three different stages:

- Product diffusion
- Process diffusion
- New concept introduction

[1]In an agricultural system, problems are continually arising so that institutional capacity to do maintenance research becomes increasingly important as development proceeds. Maintenance research avoids the collapse of the present yields from new pests and diseases.

[2]When a new sorghum hybrid was first introduced into the Sudan, both consumers and millers complained about its characteristics. Three years later, after farmers has seen its high yields, in a sample of 55 farmers, 50 reported that the taste of the "Kisra" of the new cultivar was equal or superior to that of traditional cultivars (Ahmed and Sanders, 1992).

The last would include the original introduction of hybrid maize or presently the attempt to utilize bio-technology concepts in agricultural technology development. Both (a) and (b) are relevant concepts in Malawi, both involve an imitation or adaptation process of successes in other regions. SR-52 has been an amazing success story of hybrid maize in Zimbabwe. It was released in the late 1960s and successfully introduced into Malawi as MH-12. This is an example of successful product diffusion.

Once this new cultivar and successors were introduced, two local requirements became evident. First, insect storage pests were a more serious problem with dent type maize than with the local flint type. Secondly, the pounding characteristics were also complained about by village women. In the mid-1980s, flint populations adapted to Southern Africa became available from CIMMYT in Harare. From these populations the Malawian maize breeders selected MH17 and MH18 from triple crosses with the local materials. These cultivars were released in Malawi in 1990. They provide a useful example of the evolutionary process of technology development and of process diffusion. Malawian scientists identified the required characteristics of a new maize cultivar. Then they looked for specific characteristics and for adaptation in populations provided them by the international centers. There was interaction with the demand from the field in response to farmer and processor complaints.

The Small Farm Sector

Malawi has a big advantage in developing new technologies since the process is already well known. The response of a crop to chemical fertilizer, improved cultivars adapted to the region, and other improved management practices can be observed on the estate holdings of tobacco and more recently in smallholder production of maize. Historically, in Malawi, as in other sub-Saharan African countries, the smallholder sector was considered to be self-sufficient. Efforts were focused on obtaining foreign exchange by increasing export crops. The subsistence crop sector could take care of itself. If maize productivity were substantially increased, then there would be problems of oversupply with either a falling price or large costs to the public agency, ADMARC.

Unfortunately for the smallholders, there has been rapid expansion in land holdings in the estate sector. Table 1 indicates a decrease of customary land holdings of 1.1 million ha whereas the leasehold land increased from 72 thousand to 689 thousand hectares from 1964 to 1988.

Table 1. Changes in Land Tenure since Independence

Year	Public	Customary	Freehold	Leasehold	Total
		(All figures in thousands of Hectares)			
1965 a	1106.7	8183.3	167.8	72.0	9529.7
1967 a	1206.8	8100.9	153.4	68.6	9529.7
1970 a	1525.6	7777.7	147.5	79.0	9525.7
1973 a	1592.1	7700.6	107.6	129.5	9525.7
1976 a	1681.3	7602.3	85.3	236.3	9525.7
1979 a	1674.1	7547.7	52.1	255.8	9525.7
1982 b	1659.5	7358.3	51.8	379.1	9448.7
1985 b	1641.6	7271.2	52.0	484.1	9448.7
1988 b	1641.6	7066.2	52.0	688.9	9448.7

Notes: a. Derived from the Department of Land Valuation (DLV) as reported in Mkandawire and Phiri (1987).

b. Data for Public and Freehold Land derived from same DLV registry. Leasable land was calculated from agricultural estates files for Kasungu, Nzuzu, Salima, Liwonde, Lilongwe and Blantyre ADDs. Customary land data is residual.

Source: A. Conroy (1992) taken from Mkandawire, Jaffee and Bertoli.

Estate holdings accelerated in the eighties with another 13,000 holdings. The mean size decreased from 345 ha when there were 229 estates in 1970 to 53 with 14,355 estates in 1989. The estates are concentrated in the Central Region with 77 percent of the registered estates and 67 percent of estate land. (Conroy 1992)

While the land available to smallholders has been decreasing (Table 1), population growth has continued at high rates of over three percent. One consequence has been a further concentration of small farmers on smaller land areas. In the mid-eighties an estimated 55 percent of the small farmers cultivated less than 1 ha (Table 3). The proportion was higher for female-headed households, 72 percent, as compared with male-headed households of 48 percent.

Table 2. Leasehold Estate Expansion 1970-1989

Year	No. new estates	Area leased (000 ha)	Mean sz ha	Cumulative no.estates	Cumulative area	Cumulative mean ha
To 1970	229	79	345	229	79	345
1979	876	176.8	202	1105	255.8	192
1980	216	17.3	80	1321	273.1	207
1981	765	46.9	61	2086	320	153
1982	1714	65.6	38	3800	386	102
1983	1006	49.2	49	4806	435.2	91
1984	486	24.9	51	5292	460.1	87
1985	363	31.4	87	5655	491.5	87
1986	592	26.4	45	6247	517.9	83
1987	1867	70.2	38	8144	588.1	72
1988	3839	107.7	28	11953	695.8	58
1989	2402	63.8	26	14355	759	53

Source: A. Conroy (1992) taken from Department of Land and Valuation From 1980 to 1989 from leasehold files for Kasungu, Mzuzu, Salima, Lilongwe and Blantyre ADDs.

Table 3. Small Farm Size Numbers and percent by Size Category in 1984/85

Hectare	No. (1,000)	Percent
0.0 - 0.5	299	23
0.5 - 1	420	32
1.0 - 1.5	258	20
1.5 - 2.0	142	11
2 - 3	127	10
3 +	55	4
Total	1,301	100

Source: Ministry of Agriculture, "Five Year Plan for the Agricultural Sectors in Malawi," Planning Division, Lilongwe, February 1989, p. 9.

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With these small farm sizes, it is difficult to nutritionally support a family. For many of these families, off-farm income would be an important component of family income. The estates provided wage labor for 332 thousand permanent workers in 1989 (Table 4). So they have had an important influence on earnings in this sector. Unfortunately for the agricultural workers real wages declined in agricultural employment during the 1980s (Economist Intelligence Unit, Malawi 1991, p. 14).

Table 4. Employment in the Estate Subsectors

Year	Permanent Workers	Tenants & Families (a)	Tea Estates	Other Estates	Total
	Thousands of permanent workers (farm level only)				
1977	71.7	28.9	37.9	21.5	160.0
1978	87.5	29.8	37.6	21.8	176.7
1979	99.0	40.5	39.4	23.1	202.2
1980	97.2	47.2	38.1	22.7	205.2
1981	52.9	50.0	36.6	22.0	161.5
1982	72.9	61.3	37.0	21.7	192.9
1983	85.3	117.1	37.6	23.3	263.3
1984	80.6	61.0	39.1	25.0	205.7
1985	89.7	67.9	42.8	28.7	229.1
1989	91.1	168.6	42.0	30.0	331.6

Notes: (a) is calculated by taking the number of registered tenants and multiplying by 2.5, assuming that the tenant's spouse is fully employed and that an additional adult family member is working at least part-time on the tenant plot.

Source: A. Conroy (1992) from Reported Employment and Earnings. Annual Reports Various Years; Tobacco Control Commission; Tea Association cited in Mkandawire, et al, 1991.

Chronic malnutrition is already frequently found among the smallholders. This is reflected in very poor social indicators such as high infant mortality rates, growth stunting, and deficiency diseases.

The declining farm sizes and low productivity have also turned most of the small farm sector into cereal purchasers or would be purchasers. An estimated 75 percent of small farmers have maize deficits during the year.

In the smallholder sector in the 1984/85 season, there were an estimated 1.3 million holdings with 1.490 million hectares or 1.15 ha/holding. Of these households, almost 29 percent were headed by women in this year (Kydd, 1989, p. 115).

With the small land areas available to increase farm incomes, it is necessary to increase land productivity. Hence, it is not surprising that fertilizer use has increased substantially since the mid-1960s. Another important component of land productivity improvement has been the increases in the use of improved seeds (Figure 1 and Table 5).

Table 5. Smallholder Sector Structure and Characteristics 1983/84 Season (with some comparative data from 1980/81)

	NATIONAL TOTAL OR AVERAGE	holding size in hectares					
		0-0.5 %	0.5-1.0 %	1.0-1.5 %	1.5-2.0 %	2.0-3.0 %	3.0+ %
NUMBER OF HOLDINGS	1,300,000	23.0	32.3	20.0	10.9	9.8	4.2
CULTIVATED AREA (ha)	1,488,000	6.2	20.9	21.3	16.3	20.5	14.8
	(average)						
PERCENTAGE HOUSEHOLDS HEADED BY WOMEN	28.8	42.0	34.0	24.0	18.0	10.0	8.0
PERCENTAGE HOUSEHOLDS USING SOME INORGANIC FERTILIZER	23.0	9.0	16.0	25.0	40.0	(2.0-2.5) 44.0	(2.5+)* 54.0
PERCENTAGE MAZIE AREA PLANTED TO IMPROVED SEED**	9.7	2	2	6	8	15	25
(percentage maize area planted to improved seed in 1980/81)	8.1***	4.1	5.1	8.4	9.8	11.5	17.0

* Holding size categories differ for these cells only.
** Including maize intercropped mixtures not separately identified.
*** Figures of about 10 percent are given in some other sources. These are arrived at by excluding what the NSSA classified as maize intercropped mixtures. As almost all local maize is intercropped to some extent, the arguments are not strong for excluding intercropped maize in estimated shares planted to different varieties.

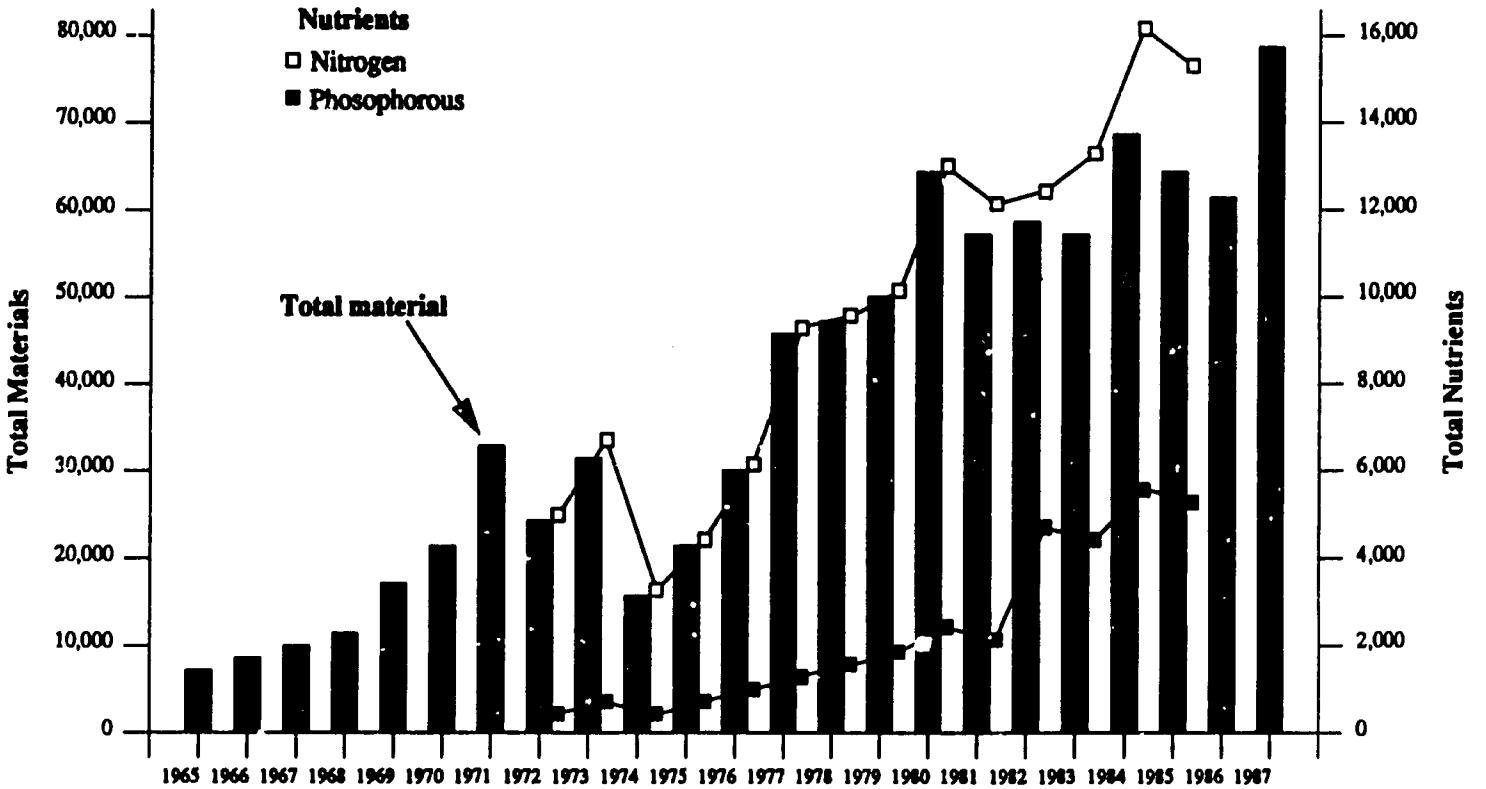
Source: Kydd, 1989. The 1983/84 data is from the Annual Survey of Agriculture (ASA) as cited in the Statement of Development Policies-1987-1996. The ASA is a medium-sized national sample survey. The 1980/81 data is from the National Sample Survey of Agriculture-1980/81, which was a large scale sample survey.

In 1983/84, 23 percent of the small households utilized inorganic fertilizers and almost 10 percent of the maize area was planted to improved maize cultivars (hybrids, composites or synthetics). So technological change in agriculture has already been taking place in these smallholder farms.

One complaint about technological change is that it is only available to men. Approximately, 75 percent of hybrid seed and fertilizer is sold on credit (Conroy 1992, "The Inputs Sector" p. 12). The proportion of women receiving credit has gone up from 12 percent in 1982/83 to 31 percent in 1990/91.

As stated previously, 28 percent of the households headed by women and 51 percent of the households headed by men were larger than 1 hectare (Table 6). If credit is oriented towards these larger small farmers, then an indication of bias for or against women would be the ratio percent credit recipients by sex/ percent with above 1 ha by sex. This ratio is 1.11 so that there is a small bias towards women with credit. Nevertheless, given the lack of land available to women, the farm income of most families headed by women would still be lower

Figure 1:
Uptake of Fertilizer by Smallholders, 1965 - 87
(in tonnes)



Source: Kydd, 1989. Kydd data files,
updated after 1973 from Christensen (1987)
and ECONOMIC REPORT 1988

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than that of male-headed households. A third division is necessary to separate those households to which husbands (or others) are sending remittances and those not receiving this income.

Table 6. Distribution of Holding Size for Male and Female Headed Households.

Cultivated Areas (hectares)	Female headed households	Male headed households	All households
	(figures are percent of households)		
0 < 0.5	35	19	24
0.5 < 1	37	29	31
1 < 1.5	16	20	19
1.5 > 2	7	12	11
2 < 3	4	13	10
> 3	1	6	5

Source: A. Conroy (1992) from Government of Malawi and UNICEF, "The Situation of Women and Children in Malawi", September 1987, cited in World Bank, 1989.

Looking at the constraints to increasing land productivity in the smallholder sector - the most pressing constraint is soil fertility. Combining soil fertility improvements with new cultivars that respond better to fertilizer would give a substantial increase in yields. The major nutrients are nitrogen (N) and phosphorus (P), but large variation in the response to P has been shown (Wendt cited in Conway 1992). There has been interest in low cost substitutes for N. Various types of agroforestry, including alley cropping and the use of Acacia have both shown promising results for N-fixation under experimental conditions. A new soybean cultivar, Magoye, also looks promising and could be rotated with the maize to reduce the N requirements. The P requirements and probably some micro-nutrients would still remain. The following sections consider maize and the above technologies in more detail.

Maize Technology

Maize is the principal dietary staple for over 80 percent of the population with an average consumption of 225-250/kg per capita annually. Maize is principally produced by the smallholders on approximately 70 percent of the cultivated area. Approximately 10 percent of the maize is produced on the estates for their workers (World Bank, "Malawi National Research Project, 2nd Triennial Review", 1992, p. 9).

With the decreasing available land area and rapid population growth, soil fertility is apparently falling as indicated by declining maize yields of 1 to 2 percent annually over the last twenty-five years (Ministry of Agriculture, 1989, p. 12). This yield decline has occurred in spite of the increasing utilization of fertilizers by small farmers since the 1960s (Figure 1).

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There is a long history of successful maize breeding in Malawi beginning in the 1940s. Both dent and flint cultivars have been introduced. Dents are preferred in most of the world since this soft starch requires less processing for animal feed and is easier to process in roller mills. Most improved material regionally adapted and available for crossing has been dent (Kydd, 1989, p. 118) However, the local maizes in Malawi are flint. The harder endosperm gives better resistance to storage insects and is preferred for the better separation in hand pounding. In the 1960s there were releases of a semi-flint hybrid, and synthetics developed locally. Two composites were released in the 1970s, UCA and CCA. In 1980/81 3.5 percent of the maize area was in composites and 4.5 percent was in hybrid. MH-12 was the Malawian name of the very successful SR-52 from Zimbabwe. In the late 1970s to mid-1980s, Malawians were sent off by the predecessor to the MARE project for maize breeding training. At the time of this final evaluation, the Director of Research and of the Maize Program were two of these individuals sent for training in the early 1980s. (Kydd, 1989, pp. 130-134).

In the mid-1980s the commercial seed company, NSCM, became concerned with declining hybrid sales. They imported Ceiby-Geigy 41-41, a earlier material that produces well under lower soil fertility conditions. Upon his return to the Malawian maize program in 1987, Dr. Zambesi began to draw on the newly developed flint populations from CIMMYT in Harare. Two flint hybrids, MH-17 and MH-18 were released in 1990. Approximately 400 tons of these two flints were produced for the 1991/92 year. This is sufficient to plant 16,000 ha. For 1992/93, 1,200 tons of MH-17 and MH-18 have been produced. This is sufficient for 48,000 ha. Some 4.5 tons will be in NCSM-41 and the rest in MH-12 and MH-16. A total of 7,400 tons of hybrid maize has been produced by the NCSM seed company. This is sufficient to plant 296,000 ha. A new seed company associated with Lever has just started into business at Blantyre. A major success story of the Malawian research system is expected over the next five to ten years from these flint cultivars. The system with private seed production and increasing fertilizer use is already in place.

New high yielding cultivars respond substantially to high soil fertility conditions. Chemical fertilizer utilization has been increasing in Malawi and is expected to continue to increase. Nevertheless, due to high transportation costs, this bulky input always puts pressure on profitability. Moreover, the public support through the operation of an effective soil testing laboratory has been inadequate. In the next section, several alternatives to reduce fertilization costs by modifying the maize cropping system are considered.

Maize Research Program Impact

The central problem of Malawian smallholder agriculture is to increase the productivity of maize. Table 7 shows the yield advantage of maize hybrids observed on farms. The hybrids, accompanied with higher fertilizer levels, yields 2 to 3 times the local maize cultivars. Area expansion of hybrid has been steadily expanding since 1986/87, reaching 16 percent of the area in maize in the drought year 1991/92 (Figure 2). After each of the recent low rainfall years, there has been an increased demand for the earlier hybrids. An acceleration of the area increase for maize hybrid is expected in the 1990s. Approximately 48,000 ha of the hybrid area has been produced for seed sales in 1992/93

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Table 7. Mean Yields of Local and Improved Maize Cultivars in Malawi 1983-1992 (kg/ha)

	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92
Local	1,037	1,034	958	953	1,094	1,052	813	872	(872)a
Composite	1,787	1,746	1,729	1,635	1,199	1,760	1,400	1,417	(1,185)a
Hybrid	2,757	3,111	2,941	2,706	2,667	2,855	2,555	2,908	(2,858)a

a. Estimates of January 1992.

Source: Unpublished Data from AGREDAT, Department of Agricultural Research, Lilongwe, Malawi.

crop year in the two new flints coming out of the program in 1990 (see Table 8). This was a major program shift from dents to the predominant flints preferred in Malawi and will have substantial benefits for the country in the next five to ten years (see Table 9). The shift to a nationally trained team turning out materials more responsive to Malawian consumer preferences can be directly linked to the training investments by the MARE and its immediate predecessor program.

Figure 2 illustrates the acceleration of the area increases in hybrid maize after 1986/87. The new maize flint hybrids are a successful product of a breeding program. However, the critical constraint in Malawian agriculture is soil fertility. Figure 3 illustrates that the real advantage of the new cultivars is their excellent response to fertilization on both low and high fertility soils. Comparing plots 1, 2, and 3 the maize hybrids always outyield local cultivars at zero fertilizer and give almost the same yields as locals at low fertilization. However, the big responses for all three hybrids at different fertility levels on farmers' fields were with substantial fertilization. Three to five metric tons/ha were consistently achieved.

Chemical fertilizer is an expensive input especially with the high transportation costs into Malawi. Hence, a research priority needs to be to reduce fertilizer costs and to find inputs complementary to chemical fertilizer to reduce the requirements for this input. Whereas chemical fertilizer levels can undoubtedly be reduced, it is unlikely that chemical fertilizer utilization can be eliminated. This issue is considered further in the sections on agroforestry and cereal-grain legume systems.

Table 8. Area of Local and Improved Maize Cultivars in Malawi 1983-1992 (ha)

	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92
Local	1,067,527	1,048,441	1,104,583	1,131,540	1,137,499	1,159,985	1,184,036	1,193,642	1,124,192
Composite	26,069	21,477	20,100	13,780	18,698	25,072	24,725	18,878	13,111
Hybrid	89,005	74,935	68,592	37,095	58,890	85,765	135,923	179,358	215,495 a

a. Seed Company estimate of available hybrid seeds planted for the next period (1992/93) is 296,000 ha., (from R.W. Grey, General Manager of NCSM, May 27, 1992).

Source: Unpublished Data from AGREDAT, Department of Agricultural Research, Lilongwe, Malawi.

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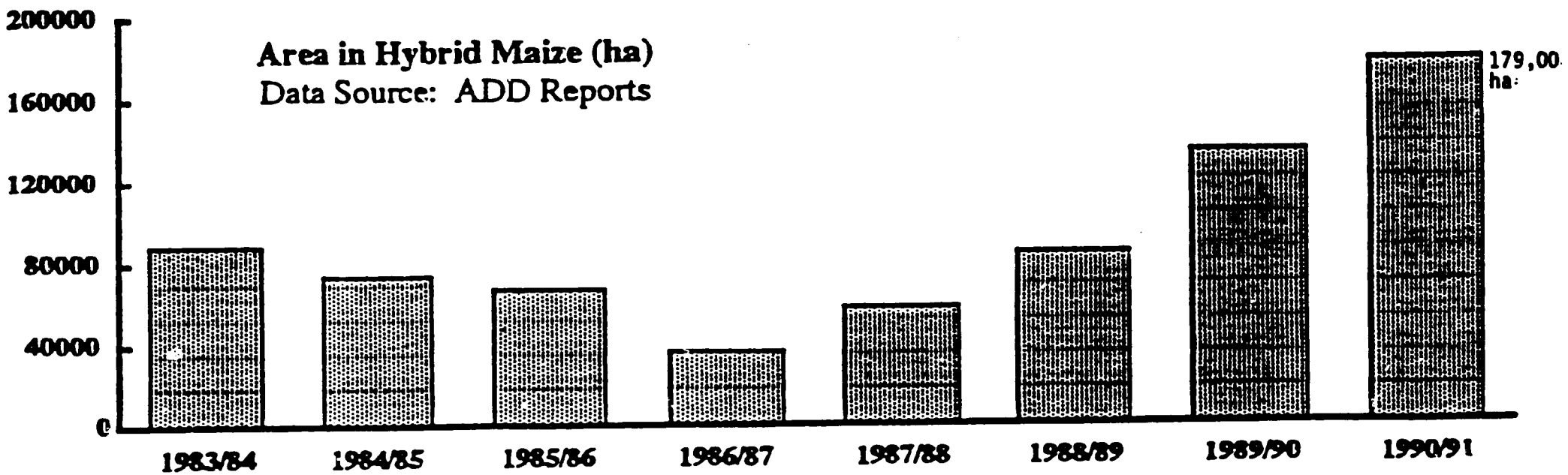
Figure 2



Source: W.R. Coffman et. al., "Malawian National Agricultural Research Project, second Triennial Review", World Bank Report, March 1992, p.40

Table 9. Source, Flint Content, Type, and Approximate Release Dates of Maize Varieties in Malawi

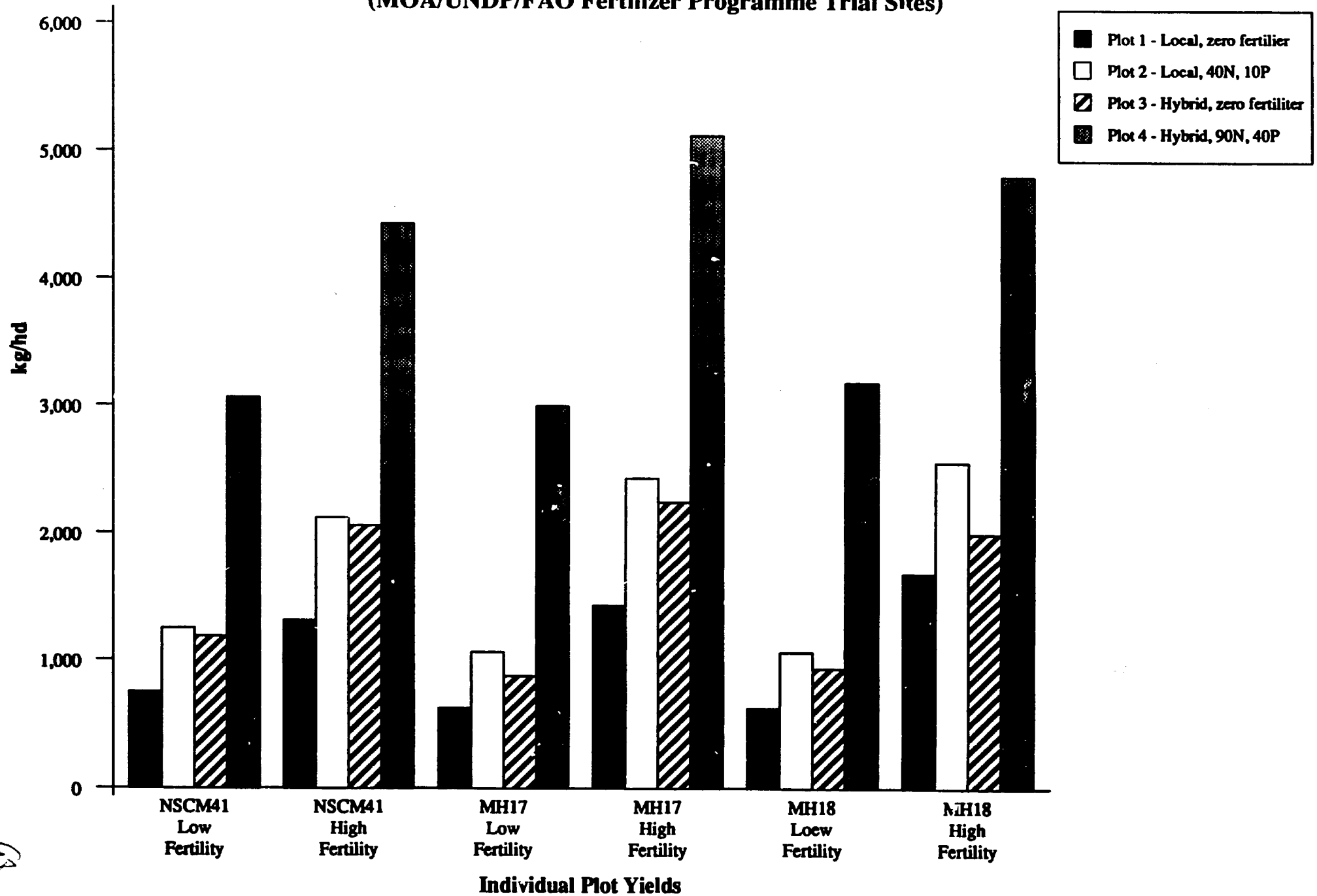
Year	Name	Flint Content	Type	Source
1959	SV17	semi-flint	synthetic	bred locally
1961	LH11	semi-flint	hybrid	Malawi Mexican Zimbabwean inbred lines, bred locally
1966	SV28	semi-flint	synthetic	East African Agriculture and Forestry Research Organization inbred lines, bred locally
1967	SV37	semi-flint	synthetic	bred locally
	SR52	dent	hybrid	imported, Zimbabwe-bred
	R200	dent	hybrid	imported, Zimbabwe-bred
1971	UCA	semi-flint	composite	Tanzania-bred (adapted)
	CCA	semi-flint	composite locally	local materials/some exotic, bred
	HG32	semi-flint	hybrid	imported, Kenya-bred (LLDP only)
	R201	dent	hybrid	imported, Zimbabwe-bred
1978	MH12	dent	hybrid	(adapted) Zambian SR52
1983	NSCM41	dent	hybrid	Ciba-Geigy 4141, import license for F1
1984	MH14-16	dent	hybrid	RSA Zimbab. germplasm, local
	CCC	semi-flint	composite	local, CIMMYT, RSA and Zimbabwe material, bred locally
	CCD	semi-flint	composite	IITA/CIMMYT/RSA bred locally
	R215	dent	hybrid	imported, Zimbabwe-bred
	Tuxpeno		composite	imported, CIMMYT
	Kalahari		composite	imported, RSA-bred
	Early			
	Pearl			
1990	MH17	semi-flint	hybrid	MH12 & CIMMYT bred locally
	MH18	semi-flint	hybrid	MH16 & CIMMYT bred locally

Source: M. Smale, "Maize is Life: Maize Research and Smallholder Production in Malawi," prepared for USAID, March 1992, 11.

(1)

Figure 3: Maize Yields in Lilongwe and Mohinji ADDS in the 1990-91 Season

(MOA/UNDP/FAO Fertilizer Programme Trial Sites)



Source: Unpublished Data of the Malawi Maize Program

Soil Fertility

In Malawian agriculture, the critical constraint is soil fertility. Substantial increases have occurred in the utilization of chemical fertilizers. The combination of maize hybrids and chemical fertilizers has been shown to substantially increase farm yields. Malawi presently has good scientific capacity to make national technical recommendations for fertilizers. This is done in the annual Guide to Agricultural Production. This guide is utilized to orient extension workers and others in applied agricultural projects. The basic nature of agriculture is its site-specific requirements, however.

Fertilizer recommendations need to vary with soil characteristics, rainfall regime, economic environment, and the degree of risk the farmer is willing to take. Malawi badly needs to make investments in its soil laboratory. Timely recommendations, at least for P, are a minimum requirement to begin to economize on the fertilizer recommendations. Adaptive trials on farmers' fields of new cultivars with different levels of fertilizers would also fill an important information gap. This information then needs to move up the command structure to revise these national fertilizer recommendations.

The Triennial Review of the World Bank in 1992 made a series of technical suggestions on more efficient utilization of the high analysis fertilizers. This World Bank report also stresses soil fertility as the most important research problem to be addressed in Malawi, giving it precedence over the commodity programs, and stressing the importance of a functioning soils laboratory.

At the present time, chemical fertilizers can be obtained and are profitable in combination with new maize cultivars. However, chemical fertilizer is often difficult for small farmers to obtain unless they are members of credit clubs. Moreover, with the high transportation costs, fertilizer is expensive. The bottom line is that technology introduction presently will need to include fertilizer. However, it will be important to develop a research agenda to provide substitutes for some of the chemical fertilizer. Two methods for doing this are agroforestry activities and cereal-grain legume rotations.

Agroforestry. The DAR with the support of the MARE Project has had an extremely successful program in agroforestry. The technical advisor, W.T. Bunderson, has now been working on this project for six years. Rockefeller Foundation has recently picked up his contract as well as providing this project a $320,000 two-year grant.

Dr. Bunderson has collected and tested species and systems. He has also actively collaborated with different development agencies to get his material out on farmers' fields. He has had trials in different Agricultural Development Districts in collaboration with their Land Husbandry units.

His results for alley cropping are especially exciting. He has produced substantial scientific work on Leucena and distributed these trials. Leucena unfortunately has two important technical problems: (a) susceptibility to termites and (b) susceptibility to browsing during establishment. Dr. Bunderson's two new bushes for alley cropping, Cassia

Spectabilis and Gliricidia Sepicum, do not have these technical problems. However, there are still only one year of results for these alley cropping systems.

Yield results for these alley cropping systems with Leucena are as follows:

	Maize yields (mt/ha)
Leave alone as mulch	1.5 to 3
Leaves + 40 kg P	3 to 5.5
Leaves + 80 kg P	6

This Leucena and Gliricidia system is presently being promoted in the 1991/92 Guide to Agricultural Production, the official government recommendations with the caution about termites. Moreover, there has been very active involvement with the farmers through various NGOs and other development programs. The most direct and systematic extension contact is with the Land Husbandry units in ADDs. This alley cropping technique has substantial potential to reduce much of the chemical fertilizer requirements for higher yields on small farmers' fields.

The system does require increased labor to prune the branches so that the maize density can be increased. Seven to nine person days/ha are required for this operation 10 to 14 days after planting. The branches are then placed between the rows of maize. The leaves serve as organic matter and the wood is used for firewood.

These are impressive results. Now they will be tested in collaboration with the ADDs all over the country on farmers' fields, substituting for Leucena with more resistant material. More information on the variations in these systems with differences in soil fertility and regional variation of the fertilizer recommendation is necessary. Moreover, in the process of the on-farm trials other insect or disease problems may be encountered so putting these trials in multiple sites will generate very useful research information.

One objective of the new systems is to provide a low cost source of nutrients to the maize. With Acacia albida below the trees maize yields of 2 to 3 tons/ha have been obtained whereas the control outside the canopy without fertilization would be 0.5 to 1.2 tons/ha. A system of thinning the Acacia (the correct scientific name now is Faidherbia albida) as it grows has been developed.

Acacia albida has a recognized effect among farmers on cereals yields. Farmers will protect seedlings but systematic planting is unknown. The agro-forestry program has developed a system of planting and thinning the Acacia. The program is working with the national program of the Forestry Department to diffuse this system and Acacia seedlings. The forestry services has 270 nurseries across the country.

Moreover, various action agencies are in the process of putting material and new cropping systems onto farmers' fields for both the alley cropping and the Acacia system.

These farm trials/demonstrations will continue to provide useful information to farmers and researchers. Economic analysis is available in Hayes, 1992.

Cereal-Grain Legume Systems. Another way to obtain nitrogen without fertilization is with intercropping or rotations. A high proportion of Malawian farmers intercrop maize with a number of grain given legumes including field beans, cowpeas, soybeans, groundnuts, pigeon peas. Grain legumes are a very important protein source in low income cereal-based systems. A new soybean cultivar, Magoye, has been released in Zimbabwe. This cultivar does not require inoculation, high yielding, and is becoming a popular cultivar among farmers there. There are some good new Malawian soybean cultivars such as Hardee but all require inoculation. Magoye is presently being tested in the research stations of Malawi.

Before the drought in January 1992, there were an estimated 15,815 mt of soybeans on 19,569 ha. Production was concentrated in Lilongwe and Kasungu. Production and yields have been increasing rapidly since 1987/88 (see Table 10).

Table 10. Soybean Area and Yields, 1986/87-1990/91

	1986/87	1987/88	1988/89	1989/90	1990/91
Area (ha)	308	960	1,671	5,893	16,128
Yield (kg/ha)	406	595	500	506	776
Production(mt)	125	452	836	2,986	12,941

Source: AGREDAT unpublished data.

ANNEX G

IMPACT OF MARE PROJECT TRAINING COMPONENT

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End-of-Project-Status: *Is the MOA Training Unit fully operational and undertaking training programs for research and extension staff?*

The specific questions in the Scope of Work concerning the End-of-Project-Status of the training component are addressed here under three topics. The questions on institutional capacity of the MOA Training Unit are addressed first. The questions on individuals receiving long- and short-term training funded by the project and their current locations are then addressed. The questions on impact and a discussion of the constraints to impact is addressed last. Also a few recommendations to help strengthen the program are included.

A. INSTITUTIONAL CAPACITY OF THE TRAINING OFFICE

Given the personnel and funding constraints outlined below, the training unit is doing an outstanding job. The staff is energetic, well organized and capable, and have made intelligent use of the technical assistance provided through MARE. Their major accomplishments include:

- Managing preparation of a five year human resource development plan for the Ministry.
- Development of a system of departmental training needs assessment, and of course planning based on the assessed needs.
- Development and institutionalization of selection criteria for overseas and in-country trainees.
- Development of course materials, and leadership participation in the training of most MOA extension personnel in interactive training techniques (discussed more fully below). Training in these interactive techniques has been requested by several other government ministries, the Natural Resources College, as well as a GTZ Project. To the degree possible, these requests have been met by inclusion of their personnel in TOT courses.
- Managing the placement and support for long-term and short-term overseas training (outlined below). Over time, this service has been expanded to include the off-shore training needs of other projects.
- Development of a computerized system for tracking training participation.

- Managing organization, placement and support for in-country training courses (outlined below).

Unfortunately, the unit has had problems in securing and retaining professional staff. For the first three years the unit functioned on a provisional basis with technical assistance from USDA. When the office was formally established in 1989, it was given three professional posts, a unit chief, a principal training officer and a senior training officer, as well as an administrative officer and a computer operator. Four additional training officers were borrowed from within DOA. The chief's position was not filled for many months, and although someone was named to the post more than a year now, he has not yet taken up the post. Tom Trail, the immensely capable technical assistant person, left in 1990, and the senior training officer resigned to enter the private sector. Two of the four borrowed trainers are no longer available, leaving the unit to function with one professional officer, two staff persons, and two borrowed trainers.

The effect of the staff shortages is that most professional time is tied up in necessary administrative tasks, and there has been a sharp reduction in the amount of technical assistance that can be given to the trainers at the ADD and RDD level who have recently been trained by the program. Because the training of trainers (TOT) strategy being used by the unit depends upon such technical assistance, these staff shortages will undoubtedly affect the long-term success of such training - unless it is addressed quickly.

Through the TOT program, a substantial cadre of in service trainers has been established. Unfortunately, the Woman's Program was unable to access TOT training for their staff until the last possible training session. Staff turnover is a problem at the ADD level also, and the ADDs need additional training and support from the unit if it is to maximize its effectiveness. By 1990, the TOT staff accomplishments included:

- 40 training officers had received TOT courses.

- 595 Subject Matter Specialists and other extension personnel had received a four week training course, given by the 40 training officers in collaboration with unit staff. The unit developed and tested a training manual for use by trainers in these courses.

- 302 Field Assistants had received a two week course given by the newly trained training officers.

- 2,300 more Field Assistants were to be trained by the end of project in 1992, and a training manual for this course was also developed by the unit. Of these 390 were actually trained. Failure to achieve full coverage of Field Assistants was due to funding and personnel constraints discussed more fully elsewhere in this section.

The unit's operating costs are provided from the MOA recurring budget, and although this is an important marker of full institutionalization, it has meant interruptions in the flow

of funds, and thus, of the training. When the unit was formally established within MOA, funds for administration and management were budgeted. Training funds were provided on a reimbursement basis, which slowed down the training because reimbursement was so slow. Nevertheless, the system worked reasonably well between 1987 and 1991. However, from April 1991 until March 1992, there were no funds for in-country training. Funding became available again in April 1992. It is not clear why the flow stopped, and then started.

Between 1986 and 1989 the Training Unit Advisory Committee met two or three times a year, providing useful input. It was particularly helpful in developing selection criteria for overseas trainees, and in the development of the MOA's five year human resource development plan. However, the committee has not met since 1989, ostensibly because all policy issues have now been decided, and so there is no need to meet. It seems likely that the committee could be helpful in resolving personnel and funding issues, as well as in longer range planning.

Recommendations:

(1) The chief, or an acceptable substitute should be put in place, and the senior trainer post filled as rapidly as possible. Posts for the borrowed trainers should be regularized, and the vacant positions filled.

(2) The reimbursement mechanism should be reexamined to see if it can be improved or replaced. Recommendations regarding financial decisions on operating costs by the GOM are outside the scope of this evaluation, but it is clear that they are affecting the accomplishment of program goals.

(3) The Training Unit Advisory Committee should resume yearly meetings to address policy and program issues.

B. INDIVIDUALS RECEIVING LONG- AND SHORT-TERM TRAINING

B1. Long-term training overseas

Forty-eight participants received long-term overseas training at major American land grant universities: 33 from DAR, and 15 from DOA.

Department	Ph.D.	Discipline	MSc	Discipline
DAR	4	2 agronomy 2 horticulture	29	24 ag specialties 5 economists
DOA	0		15	5 social science 10 natural science

Twenty percent of those receiving MSc level training were women; however, no women received PhD level training. All but two trainees are back in country; one of those

remaining is completing a PhD with government permission. Three additional MSc level agronomists, one of whom is a women, began training under MARE's predecessor and finished with MARE funding.

All those who returned are working in Malawi, most within the government. The biggest losses to the government have been among economists because demand far outruns the supply of Malawian economists. From DAR, six trainees have left: three agricultural economists went to ODA, USAID, and Estate Extension; one agronomist to Smallholder Sugar; one agronomist and one agricultural engineer have gone to TRIM. One participant left DOA for TRIM.

The 96 percent rate of participant returns to Malawi is exceptionally high. Combined with the fact that nearly all trainees completed their course work in two years, efficiency of training was high and wastage very low. Considering that at least 15 did their thesis or dissertation work in Malawi, the record is even more impressive. It would be useful for the training officer to collect and list these research documents. The research documents should be centrally located and available to both Malawi and outside scholars. A seminar series for presentation of this research would also enhance Malawian research capabilities.

B2. Short-term overseas training

Thirty four trainees received short-term training overseas. Of these:

- 31 person months were for DOA in areas of media production, training, income generation etc.
- 32 person months were for DAR in areas such as vegetable, animal and fruit production, and soils.
- 25 percent of trainees were women.

All trainees completed on time, and all returned to Malawi. A complete listing of overseas participants, schools, disciplines, etc., is included as Annex H, MARE Project Long-Term Courses.

B3. In-country Training

In-country training was given principally in two areas, technical training in agricultural subjects, and management training. Approximately 50 technical courses are given each year to staff in DAR and DOA, much of it at or below the ADD level. MARE funds were used to improve the quality of training through TOT, as well as for provision of some outside technical assistance in areas such as irrigation, credit, plant quarantine, pesticide education and development of annual work plans.

Three courses were also conducted on **Diffusion of Results of Agricultural Research** for participants divided equally between DAR and DOA, in a continuing effort to improve

communications between the two. Workshop evaluations were positive, but assessments of their impact on improved communications have varied.

Given the structural changes in MOA related to the Commodity Research Teams and Adaptive Research Teams, substantial in-country training in management has been given. The long-term goal is development of participatory management systems. Much has been done with outside technical assistance, but there has also been an effort to build internal training capacity in this area. This is reflected in development of a long term management training strategy for MOA, developed with the assistance of a USDA consultant. The approach has been thorough and systematic; it began with a series of management seminars where senior managers identified training needs for themselves and their departments.

ISNAR then conducted a series of management courses for DAR personnel, and USDA conducted two courses on management of research station farms. MOA utilized expertise from Mananga in Swaziland, and ESAMI from Tanzania, as well as short courses from the Malawi Institute of Management. For sustainability, outside experts trained mid-level officers who then assisted in the training of 120 POs and more than 80 DOs. Follow-up sessions for the trainees are strengthening their capacity over time.

In sum, this is an impressive effort, but it is far from completed. Continuing systematic effort must be made to sustain and enhance the efforts begun.

C. IMPACT OF TRAINING ON MOA CAPABILITY/PERFORMANCE

At the simplest level, the impact of training on individual trainees, a study done by Long and Jimmerson (1990) of participants in all three NRDP V staff training projects 66 percent ranked their US education very relevant to Malawi's agricultural development objectives, and another 26 percent ranked it somewhat relevant. Short course respondents also ranked relevance highly. A high proportion of respondents also indicated that they were utilizing what they had learned on the job, and that this utilization seemed to increase with the second position held. Since the professional life of MARE graduates back on the job was typically six to twenty years, this finding promises a long term effect on the functioning of the Ministry.

The in-country TOT program was more directly targeted at improving the ability of the extension system to communicate with farmers effectively. Previous surveys of farmers had indicated that they ranked the extension agents technical knowledge and ability quite highly, but were somewhat less enthusiastic about their ability to deliver messages. The primary purpose of the TOT was to improve teaching and interaction skills of the entire extension system, from SMS down to the FAs. Participants in this training consistently ranked its usefulness and relevance very highly in their evaluations at the end of the sessions and again, several months later. There is substantial anecdotal evidence that these newer methods of training are percolating through the system and reaching farmers. Although there is no farmer impact study for the MARE project, use of similar methods in Malawi by the World Bank, Rockefeller and UNICEF "indicate an on-farm gain in productivity when FAs use TOT principals to interact with smallholder farmers."

It is more difficult to assess long-term impacts of such intensive and extensive training on the functioning of the Ministry. Just before MARE began, the 1985 INTERPAKS study judged the MOA technology generation and transfer system to be effective, well organized, and capable of learning from experience. In the ensuing seven years, the system has been profoundly perturbed by a series of donor interventions and outside shocks, as well as by the comings, goings, and post reassignments associated with the training process. It will take some time for the system to readjust to a new equilibrium and the process will undoubtedly demand patience and good judgement on the part of all stakeholders.

It is a tribute to the strength, stability and resilience of the system that it was able to function effectively through this period. Such qualities bode well for the long-term capacity of the Ministry to absorb and utilize the current increase in trained personnel, but the process will undoubtedly take time, and there will, inevitably, be stress in the system as it unfolds. At present, there is a great deal of "new wine in old bottles", and pressure is building in several parts of the system, as highly motivated and intelligent people try to do what they have learned how to do in systems that partially constrain their performance.

Among the areas where increased capacity is placing stress on current arrangements of the system are the following:

- Arrangements for commodity teams to do regional and on-farm trials.
- Ability of the ADDs to adapt recommendations and packages to regional differences.
- Technology approval and release system.
- Effective means of feedback from farmers to researchers. This is particularly problematic for women farmers, and those with holdings of less than a hectare.

These are all areas where the current institutional arrangements need to be rethought and renegotiated over time. It is not completely clear how donors can be most helpful in this process. Their ability to provide technical assistance on organizational issues is more limited than in areas of agricultural production and policy, and, given the pattern of donor misunderstanding of Malawian institutional realities over the past decade, donor caution seems warranted.

However, there is an area of constraint where the donor community has substantial influence and responsibility, and that is in the **area of recurring costs**. Both salary levels and adequate funding of operating costs are directly linked to this issue.

The INTERPAKs study of the Malawian system noted that:

"generally, resources allocated for programs and operations (P&O) should be at about the same level as for salaries to insure that researchers have sufficient resources to conduct their research programs... Such balance is particularly

true for applied and adaptive research programs that have considerable travel to off-station research sites... Currently [1985] 40% of the recurring costs of the ADDs are funded by the Development Accounts and it will be very difficult for the government to maintain this level of recurring costs as donor funds end in current projects. It is usually hard to cut staff so P&O declines, and system efficiency declines with it... There is evidence that this is beginning...since resources for P&O in recurring budgets declined from 47% at the beginning of the 1980s to 37% for 1985-86. This is largely the result of the large IBRD and GTZ-funded integrated development projects of the late 1970s when NRDP began." (pp 5-7)

Between 1985 and 1991, the imbalance between salaries and P&O funds appears to have increased further, as evidenced by the many references to operation cost constraints in this evaluation. Having once made the costly mistake of creating a situation where salary costs far outpaced available GOM operating funds, it behooves both donors and the government to move cautiously in addressing these issues now.

Absence of sufficient **operating funds** came up repeatedly in discussions with every stakeholder. Often it was a question of funds for relatively small amounts: for computer paper and discs, for sufficient paper to print 500 copies of research and extension bulletins so that they could be distributed to the RDP and Block level, rather than the current printing level of 50, which is sufficient only at the ADD level. Motor fuel was an issue for transportation to both training and research sites. Finally, both the Training Office and the Women's Program had experienced long term interruptions of transportation, training and demonstration funds from the recurring budget. These limits and interruptions do not appear to be as great as in many other countries with similar economic levels, but they do demand serious consideration.

Salary levels are a more complicated issue. In 1980, before the major donor presence, Malawi had consciously developed a relatively flat bureaucratic structure. It was run by Malawians, and a small group of British Expatriates. Few had been trained outside Malawi, the bachelors degree was the norm, pay was relatively low, and rural/urban differentials were much lower than in most of Africa.

When it was decided to upgrade Malawian research capacity, a relatively small number were sent out for training under the Florida project, but by 1985, with NRDP V, the trickle turned to a flood, and over a hundred Malawians went abroad for advanced degrees, including nineteen doctorates. At the time, the question of recurring costs was raised by some "old Malawi hands" who questioned whether the country could afford to reabsorb so much relatively high priced human capital, and whether these projects were raising expectations which could not, in fact, be fulfilled.

This recurring cost question was addressed in the MARE project paper, and three scenarios were projected:

(1) The MOA recurring cost budget increases by 7 percent by 1995 to cover the

increased costs of MARE and IDA projects. This scenario assumes no cost saving from efficiencies.

(2) The MAO recurring cost budget increases by 4 percent if MK545,000 is saved by closing excess regional research stations. MK40,000 is saved from Extension Aids efficiencies. 1 percent of MOA budget is saved through efficiencies.

(3) Considering only MARE, and the IDA financed research costs related to Mare, MOA operational costs will increase by 2 percent. No calculations are given in the PP, so it is difficult to know how realistic these projections are, and in particular what assumptions they were making about salary. Given recent salary increases for the entire Ministry, recurring costs will undoubtedly exceed those predicted.

Whatever the cost projections, the country is now in possession of significantly greater amounts of human capital, and is struggling with ways in which it can be recompensed. The greater spread of training demands a greater spread in salaries, but higher salary differentials have recurring cost implications. Yet it is feared that lack of higher salaries will cause people to leave government service, and perhaps to leave Malawi. The fear is realistic. To date, at least six MARE trained people have left government service for the private sector, but none have yet left Malawi.

A recent study by a World Bank consultant found that between 1985-1991, 31 people, which was 32 percent of the professional staff (those with MSc or PhD level degrees) had left the Department of Research. This has been cited as evidence that trained personnel were being bid away by higher salaries. Closer examination of the data however, shows the data to be more complex.

- 10 retired: 3 Ph.Ds went to TRIM, where retirement age is higher than 50 years.
- 3 were seconded to another unit.
- 2 were promoted and transferred - including 1 to Principal Secretary.
- 11 resigned, and went to jobs outside the government.
- 1 absconded.
- 4 unknown.

Comparable figures for the Department of Agriculture professional staff who left during the same period are not currently available but appear to be lower.

Thus, to date, some (probably in the range of 10 to 15 percent) trained Malawians have left the government service for the private, parastatal and donor sectors; none appear to have left the country. Many of these seem to have left at or near the mandatory retiring age of 50. Over the longer run more may leave, due to low salaries, constrained operating

funds, or general frustration if the organization of the system isn't adjusted to permit them to efficiently perform the work for which they are trained.

This is a real dilemma for the country, and the donor community, who have collaborated in the creation of a highly motivated, energetic group of African agricultural scientists and extension personnel. The country badly needs them, but may not be able to afford them, at least in government service. Creative solutions are called for.

Recommendation:

A study be commissioned on the recurring cost problem as it relates to issues of salary and operating costs for the Ministry as a whole. It should include an examination of the systems available for improving the salary reward structure and working conditions of both DAR and MOA and the possibilities for adjustment of the retirement age, as well as the system-wide impact of proposed changes. The study should be done by people with a firm, practical grasp of institutional realities, as well as financial issues.

ANNEX H

MARE PROJECT LONG-TERM TRAINING COURSES

MARE LONG TERM COURSE
APPENDIX 1(C)

NAME	DEPT.	DEGREE FIELD	UNIVERSITY	STARTING DATE	ESTIMATED DATE OF COMPLETION	STATUS	WORK HOME BEFORE TRAINING	WORK DOING AFTER TRAINING
1. M.N. Soko	DAR	M.Sc. Plant Breeding	Colorado	2 May, 1987	30 August, 1989	Back	Plant Breeding	Plant Breeding
2. G.M. Bella	DAR	M.Sc. Ag. Economics	Illinois	11 August, 1987	30 August, 1989	Back	Adaptive Research	Resigned, USAID
3. D.H. Jere	DAR	M.Sc. Ag. Economics	Michigan	5 September, 1987	30 August, 1989	Back	Adaptive Research	Resigned, ODA
4. F.N. Nyirenda	DAR	M.Sc. Agronomy	Colorado	27 September, 1987	30 August, 1989	Back	Adaptive Research	Resigned, Sugar Authority
5. L. Chisambiro	DAR	M.Sc. Agronomy	North Carolina	1 August, 1987	30 August, 1989	Back	Agronomy Research	Resigned, TRIM
6. C.T. Chizala	DAR	M.Sc. Horticulture	Tuskegee	26 December, 1987	30 December, 1989	Back	Horticulture	Horticulture
7. Y. Mbekeani	DAR	M.Sc. Forestry	Washington State	26 December, 1987	30 December, 1989	Back	Agro Forestry	Agro Forestry
8. D.M. Kalumbi	DAR	M.Sc. Ag. Economics	Washington State	26 December, 1987	30 December, 1989	Back	Adaptive Research	Resigned Estate Ext. Trust
9. M. Lowole	DAR	PhD Agronomy	Auburn	12 September, 1987	30 September, 1991	Back	Soil Survey	
10. C. Chanika*	DAR	M.Sc. Agronomy	Kansas State	27 December, 1985	1 July, 1988	Back	Agronomy Research	Smallholder Coffee Authorit Secondment
11. C. Moyo*	DAR	M.Sc. Agronomy	Kansas State	27 December, 1985	30 May, 1988	Back	Adaptive Research	Adaptive Research
12. P. Nguira (Mrs)*	DAR	M.Sc. Maize Breeding	Missouri	22 August, 1985	31 March, 1988	Back	Plant Breeding	Plant Breeding
13. E. Sibale (Mrs)*	DAR	M.Sc. Maize Breeding	Missouri	22 August, 1985	30 May, 1988	Back	Plant Breeding	Plant Breeding
14. F. Kadwa	DAR	M.Sc. Irrigation Agronomy	Wyoming	7 January, 1989	31 December, 1990	Back	Irrigation Agronomy Research	Irrigation Agronomy Research
15. E. Msiska (Mrs)	DAR	M.Sc. Agronomy	Colorado	7 January, 1988	30 August, 199v	Back	Agronomy	Not back
16. M. Kanyika	DAR	M.Sc. Rice Agronomy	California	19 August, 1988	30 August, 1990	Back	Rice Breeding	Rice Breeding
17. M.E. Nyirenda	DAR	M.Sc. Agronomy		May, 1989	April, 1991	Back	Agronomy Research	Agronomy Resear
18. E.M. Chilembwe	DAR	PhD Horticulture	Michigan	6 June, 1987	30 September, 1991	Back	Horticulture	Horticulture
19. M.C. Chitsanya	DAR	M.Sc. Animal Production	West Texas	20 May, 1987	30 August, 1989	Back	Livestock Research	Not back
20. D.B. Singa	DAR	M.Sc. Agric. Engineerin	Wyoming	20 May, 1987	30 August, 1989	Back	Farm Machinery Research	Resigned - TRIM
21. M. Kawonga	DAR	M.Sc. Agronomy	Tennessee	2 August, 1987	30 August, 1989	Back	Agronomy	Agronomy
22. J.B. Kumwenda	DAR	PhD Agronomy	Georgia	2 January, 1988	30 August, 1991	Back	Agronomy	Agronomy
23. M. Gondwe	DAR	PhD Horticulture	Cornell	14 January, 1988	30 August, 1991	Back	Horticulture	Horticulture
24. J.D. Mdengu	DAR	M.Sc. Agric. Economics	Colorado	26 December, 1987	30 December, 1989	Back	Adaptive Research	Adaptive Research

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NARE LONG TERM COURSE

APPENDIX 1(C)

NAME	DEPT.	DEGREE FIELD	UNIVERSITY	DATE	ESTIMATED DATE OF COMPLETION	STATUS	WORK DONE BEFORE TRAINING	WORK DOING AFTER TRAINING
1. K.M. Phiri	DOA	M.Sc. Farm Management	West Virginia	11 August, 1987	30 August, 1989	Back	Training Officer	Economist
2. C. Chibwana (Mrs)	DOA	M.Sc. Horticulture	Washington State	18 July, 1987	30 August, 1989	Back	Women's Programme	Women's Programme
3. M.B. Bodzalekani	DOA	M.Sc. Agronomy	Wyoming	19 August, 1987	30 August, 1989	Back	Project Officer	Crops Officer
4. M.L. Mlotha	DOA	M.Sc. Agronomy	Kansas	11 August, 1987	30 August, 1989	Back	Project Officer	Crops Officer
5. F.L. Mhlane (Mrs)	DOA	M.Sc. Ag. Extension	Oregon	9 May, 1967	30 September, 1989	Back	Women's Programme	Women's Programme
6. E.D. Mpachika	DOA	M.Sc. Ag. Extension	West Virginia	11 August, 1987	30 August, 1989	Back	Project Officer	Project Officer
7. A.P.G. Mambala	DOA	M.Sc. Ag. Communications	Cornell	7 January, 1989	31 December, 1990	Back	Crops Officer	Communication Officer
8. D. Manthokwe	DOA	M.Sc. Adult Education	Cornell	26 December, 1987	31 December, 1989	Back	Principal Training Officer	Retired
9. C. Masangano	DOA	M.Sc. Agronomy	Michigan	26 December, 1987	30 December, 1989	Back	Project Officer	Project Officer
10. A. Mtika	DOA	M.Sc. Agric. Food Nutrition	Washington State	26 December, 1987	30 December, 1989	Back	Food and Nutrition	Food and Nutrition
11. F. Kalowekamo	DOA	M.Sc. Agric. Environment	Suny Syracuse	26 December, 1987	30 December, 1989	Back	Environmental Education	Environmental Educati
12. G.S. Phiri	DOA	M.Sc. Land Resource Survey	New Mexico	2 August, 1988	30 August, 1990	Back	Land Husbandry	Land Husbandry
13. J. Mwambaghi (Mrs)	DOA	M.Sc. Food Science and Nutrition	South Carolina	1 January, 1989	31 December, 1990	Back	Training Officer	Nutrition

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25. L. Msagate	DAR	M.Sc. Seed Technology	Mississippi	26 December, 1987	30 December, 1989	Back	Seed Technology	Seed Technology
26. P.M. Jere	DAR	M.Sc. Agronomy	Tuskegee	20 August, 1988	30 August, 1990	Back	Adaptive Research	Adaptive Research
27. A. Itimu	DAR	M.Sc. Agric. Forestry	Washington State	26 December, 1987	31 December, 1989	Back	Agro-Forestry	Agro-Forestry
28. T. Chilanga	DAR	M.Sc. Veg. Production	Oregon	13 March, 1988	31 March, 1991	Back	Vegetable Research	Vegetable Research
29. G. Kauta	DAR	M.Sc. Irrig. Agronomy	New Mexico	26 December, 1987	31 December, 1989	Back	Irrigation Agronomy	Irrigation Agronomy
30. G.W. Lupiya	DAR	M.Sc. Computer Science	Oregon	22 March, 1988	30 March, 1990	Back	Computer Science	Computer Science
31. R. Mwenda	DAR	M.Sc. Prod. Economics	Oregon	22 March, 1988	30 March, 1990	Back	Social Economist	Social Economist
32. M.J. Mdala	DAR	MPA/Agriculture	Louisiana	23 May, 1989	30 May, 1990	Back	Accounting	Accounting
33. V. Kabambe	DAR	M.Sc. Agronomy	Kansas	28 August, 1988	28 May, 1990	Back	Maize Agronomy	Maize Agronomy
34. A. Longwe	DAR	M.Sc. Agronomy	Colorado	27 January, 1988	31 January, 1991	Back	Adaptive Research	Adaptive Research

* Denotes participants who started Masters Degree training Programme with the balance of Florida Funds and later with MARE Funds.

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NAME LONG TERM COURSE

APPENDIX 1(C)

NAME	DEPT.	DEGREE FIELD	UNIVERSITY	DATE	ESTIMATED DATE OF COMPLETION	STATUS	WORK DONE BEFORE TRAINING	WORK DOING AFTER TRAINING
1. G. Malindi (Mrs)	ATD	M.Sc. Adult Education	Illinois	29 December, 1989	31 December, 1990	Not Back		
2. M.S. Kamuche	PD	M.Sc. Ag. Economics	West Virginia	28 August, 1987	30 August, 1990	Back	Passed Away	
3. F. Chirwa	PD	M.Sc. Agric. Economics	West Virginia	28 August, 1987	30 August, 1990	Back	Agro Economic Survey	Budgetting and Sectoral Planning

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ANNEX I

DAR ORGANIZATION, AGREDAT, AND THE ARC

ANNEX I
DAR ORGANIZATION, AGREDAT, AND THE ARC
DETERMINING PRIORITIES AND OTHER AGREDAT FUNCTIONS

The second item in the Logical Framework was that the ARC develop a system for evaluating and setting research priorities. To do this, a data bank was to be established. Economic/financial analyses were to be conducted for each NRCU to determine the feasibility of their proposed research and to verify the economic viability of results. The ARC would require those economic analyses before making the funding decisions (see Annex A for more details).

AGREDAT was set up to be this data collection and economic analyses institution. This scheme initially sounds brilliant but it would make AGREDAT a screening device between the commodity programs and the ADDs, as illustrated below:

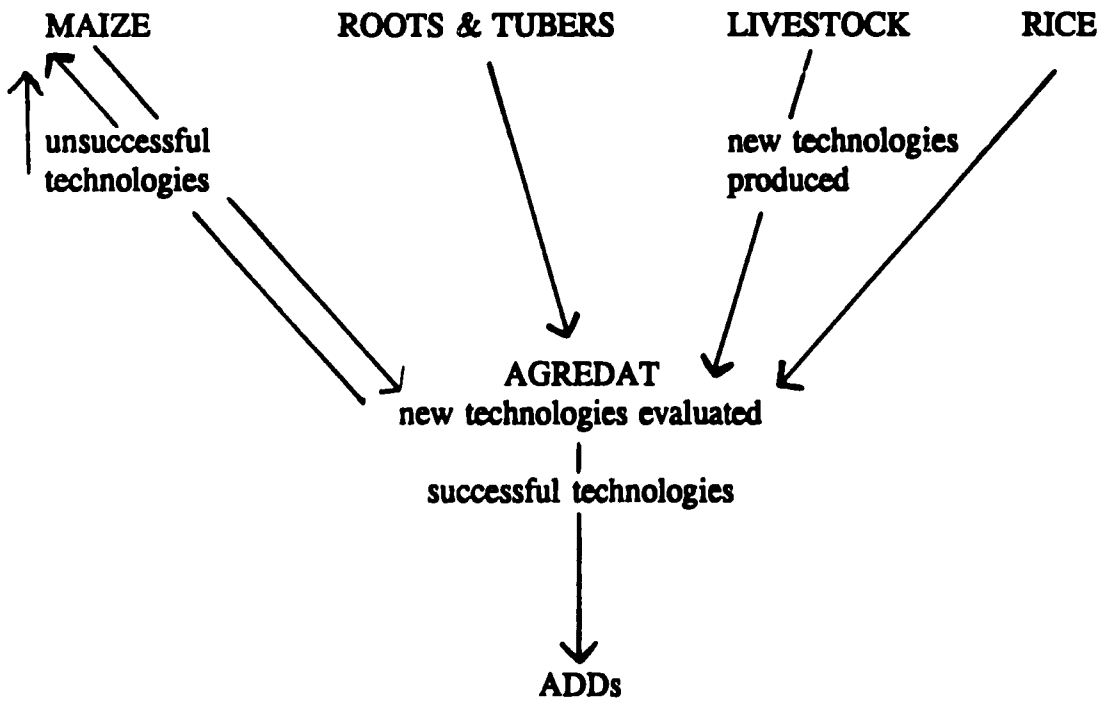

Figure 1: Technology Flowchart for Commodity Programs

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Under this scheme, all new technologies would be screened by AGREDAT. If the technology passes the financial/economic analysis, it could go onto the ADDs. If not, it would be returned for further modifications on the experiment stations. Moreover, those economic/financial analyses would be utilized by the ARC to evaluate how the commodity program is performing for the annual funding decisions. This is too much pressure for an organization to survive. AGREDAT would become the barrier for moving technologies further in the system.

In practice AGREDAT was set along side the commodity programs as shown below, and occasionally provided some inputs into those programs on technology viability. However, it did not become the technology clearing house it was intended to become. It did help on technology priorities, but not in the method foreseen in the Logical Framework.

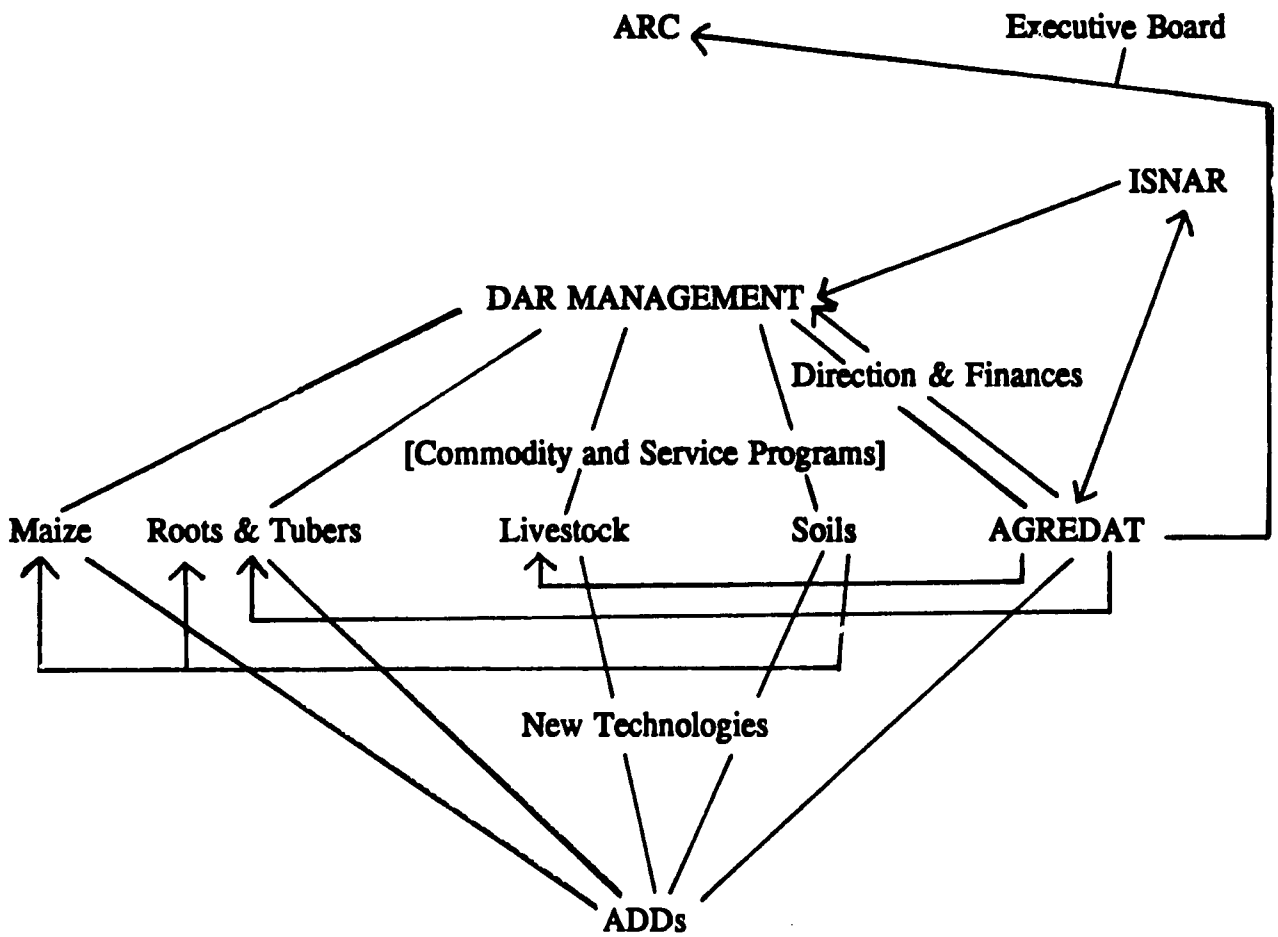

Figure 2: Actual Technology/Management Flowchart

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In Figure 2, the services units, such as Soils and AGREDAT, provide inputs to the commodity teams as requested. The World Bank report proposed that the commodity teams would pay for those part-time services of economists, soil labs, and statisticians. In this scheme there is more voluntary interaction. To the extent that the AGREDAT did good economic analysis, this input would be appreciated by both the commodity teams and the ADDs.

In practice, a new player appeared in the picture, ISNAR, the international center for advising the national research organizations. In their workshop in Mzuzu in 1990, ISNAR and the DAR developed a consensus to utilize a scoring methodology to evaluate all the commodities and thereby set priorities. This system was then implemented by AGREDAT for the 1991 budget analyses of the ARC. It was utilized for budget allocations and it was institutionalized in the DAR in 1992. This was an impressive management improvement for the DAR and an outstanding achievement for the AGREDAT and ISNAR.

In the rest of this annex, the functioning of this priority identification system will be discussed first. Then some overall organizational, management problems will be reviewed.

Priority identifications for research expenditures in the DAR

The actual budgetary allocations are reported for 1990/91 for the DAR. Soils and Plant Services are slightly ahead of the two principal commodity groups, Maize and Livestock. Pastures, Cotton and Rice are the next two commodity groups. Roots and Tubers is not very far behind Rice, but Sorghum-Millet, Vegetables and Tropical Fruits have much smaller allocations.

In a workshop in Mzuzu in the spring of 1990, research and extension personnel with ISNAR adopted the efficiency, equity and stability criteria for evaluating the commodities listed in Figure 3. There are two largely subjective decisions to be made by high level management:

a. First, the values of the criteria 2 through 5 involve subjective probability estimates.[1] How much can yields be increased? What is the probability of scientific breakthroughs? What will adoption be? What will happen to demand shifts? The demand shifts were largely, but not entirely, domestic. Ultimately, all commodities including the research contracted out, such as tea or field beans, would be evaluated in this manner.

b. Once these criteria are established for all the commodities, a weighting scheme still needs to be employed to give an overall ranking. This choice is also very subjective. Whose weights should be utilized: farmers, researchers, national policy makers? To overcome this problem, sensitivity analysis was done on the ranking schemes.

[1] Criteria 1, 6, 7, and 8, apparently involve only the collection of secondary data and appear more objective. However, this is an illusion because the desired criteria are the future positions of these commodities and making the assumption that the future will be like the past is very subjective and probably wrong.

Figure 3: 1990-91 Total Expenditures (Malawi Kwacha)

Source: Coffman, et al, "Malawi National Agricultural Research Project, Second Triennial Review," World Bank, Lilongwe, Malawi, March 1992, p 41.

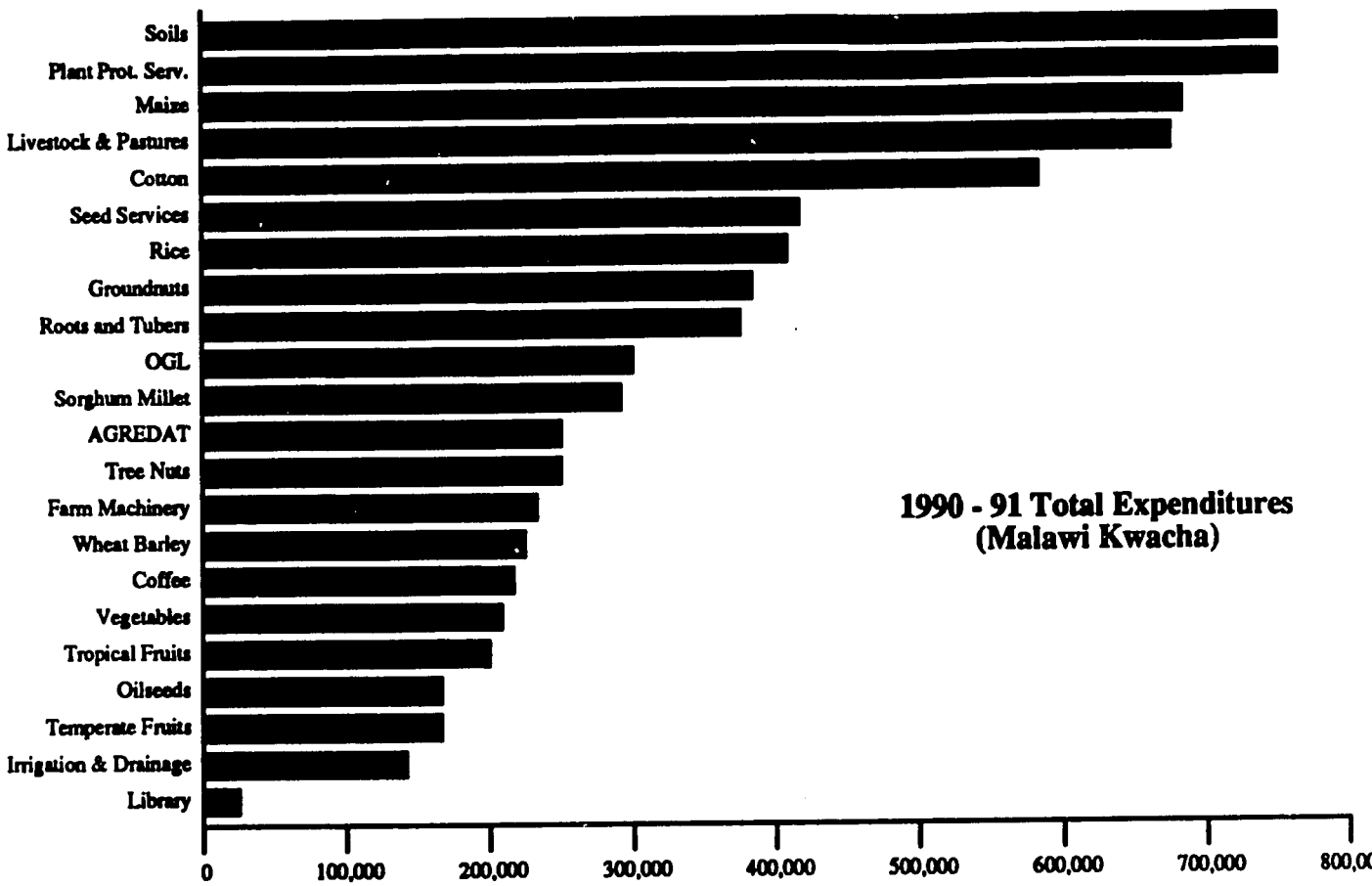

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Table 1: Goals, Objectives and Criteria for DAR Research

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. Value of production. 2. Expected yield increase or cost reduction over 5 years. 3. Expected probability of research success. 4. Expected level of adoption by farmers.
	2. Give additional weight to rural income growth.	5. Expected change in future demand. 6. Percent of farmers.
2. Improve the well-being of particular groups. (distribution)	3. Give additional weight to low income/nutrition households.	7. Percent of each commodity consumed in same household where it is produced.
	4. Reduce year-to- year fluctuations in income and nutrition.	8. Annual variation in value of production.
3. Improve the stability of level of well-being. (stability)		

Source: G. Y. Mkamanga, L. D. M. Ngwira, and T. J. Cusack, "Setting National Agricultural Research Priorities for Household Food Security: The Malawian Experience," in M. Rukuni and J. B. Wyckoff (editors), Market Reforms, Research Policies and SADCC Food Security, University of Zimbabwe, Michigan State University Project, Department of Agricultural Economics and Extension, University of Zimbabwe, Harare, Zimbabwe, May 1991, p 271.

However, the senior researchers and extension personnel would seem to be an ideal group to at least make the first cut at these estimated criteria and weights. Then over time these criteria and weights could be re-analyzed and revised with more empirical analysis and a broader range of expert and farmer opinions. Nevertheless, these criteria enable much more data input and systematic analysis than the priority ranking of the Agricultural Research Master Plan of 1988. In this plan, commodities were ranked according to their contribution to the four long-term goals of the government:

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- Maintenance of food self-sufficiency
- Increase in exports of agricultural products
- Promotion of the production of cash crops
- Encouragement of import substitution

Even though the criteria and weights from Table 1 are fairly subjective and based upon expert opinions, they are much more operational than those utilized in the earlier Master Plan exercise.

Table 2: Commodity rankings by value of production, with the efficiency index, and with the entire index at different weights for the different criteria.

	Value of Production	Efficiency	Total Ranking A	B	C
Maize	1	1	1	1	1
Roots & Tubers	2	2	2	3	3
Groundnuts	3	8	8	8	8
Livestock	4	3	3	2	2
Legumes	5	6	6	6	6
Cotton	6	10	10	12	10
Vegetables	7	4	4	5	4
Tropical Fruits	8	5	5	3	5
Rice	9	9	9	9	9
Sorghum/Millet	10	7	7	7	7
Oilseeds	11	12	12	11	12
Wheat/Barley	12	13	13	14	13
Temperate Fruits	13	11	11	10	11
Coffee	14	15	15	15	15
Treenuts	15	14	14	13	14

Source: Taken from Mkamonga, Ngwira, and Cusack, p 275.

Definitions for the different ranking schemes are given below:

Efficiency Index = (value production) * (incremental value) * (probability success) * (adoption level) * (future demand)

Total Ranking A = 0.85 (efficiency index) + 0.05 (farmer rank) + 0.05 (consumption rank) + 0.5 (annual variation)

Total Ranking B = 0.55 (efficiency index) + 0.15 (farmer rank) + 0.15 (consumption rank) + 0.15 (annual variation)

Total Ranking C = 0.70 (efficiency index) + 0.15 (farmer rank) + 0.15 (consumption rank)

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Even if only congruence analysis (efficiency index in Table 1) is utilized or the correspondence of the value of production to the research investments, there would be substantial changes from the 1990/91 expenditures. Roots-Tubers, Vegetables, and Tropical Fruits would all move up. Livestock, Cotton, and Rice would all move down. With the different criteria weighting, Groundnuts and Cotton move substantially down. Vegetables, Tropical Fruits, and Sorghum-Millet move up substantially.

There is now information of various types and some of this information was incorporated in the deliberations of the ARC in making the final research resource allocation decisions for 1991-1992. Nevertheless, the commodity priority ranking has to be judged a success just for getting the DAR administration and the ARC to take another look at their expenditure patterns.

The weightings above give a higher weight to equity than previous expenditures. Cassava is the staple food for 2.5 million consumers and Sorghum-Millet for 600,000. These crops are also more drought resistant than Maize so they could expanded in their area to insure more food security in low-rainfall years.

The more difficult calculation is to allocate between service organizations, experiment stations, AGREDAT, and the management structure. For the initial calculations, all service functions were divided between commodity programs. Soil testing and economic analysis are done for specific commodities. Not all expenditures are that easy to allocate, but this overall division was done. Then these total allocations were compared with the rankings schemes. One outcome of this analysis will be the recognition of the need to utilize financial record-keeping for management objectives. Present bookkeeping is by line item such as labor or transportation and does not allocate between commodity programs and within commodity programs between disciplines. Both the commodity program leaders and the DAR management need this type of financial information for management decision making.

The actual allocation for the various service organizations was not undertaken with the weighting system but was also a management decision of the ARC.

One way to treat the service functions is for the commodity programs to contract the services of other scientists or specific services. The Maize program could contract and pay AGREDAT for the part-time services of an economist and the Soil services for soil testing of experimental and farm level plots.

The prioritization process was also extended to disciplines within commodity programs. The weighting was simple with the senior scientists just asked about the probability of research breakthroughs in each discipline. Three priority groups were identified with the highest priority for commodity programs being Breeding and Agronomy. There are some conceptual problems here, especially:

a. the synergistic effects of multi-disciplinary work;
b. the changing requirements for disciplines depending upon the specific problem or constraint being addressed.

The second Triennial Review of the World Bank, while recommending sufficient bookkeeping so that commodity team leaders could identify disciplinary expenditures, discouraged setting these research priorities outside the teams. In practice, the within-commodity-discipline decisions were not undertaken by the ARC but were left to the commodity team leaders and other DAR management.

One of the most interesting management suggestions for greater impact came from the bank review and was directed at commodity teams. They argue that the goals of commodity teams such as Maize, should be defined in operational terms rather than in scientific terms as is presently done. Instead of measuring research performance by yield differential of new cultivars with locals, team success would be reflected in percentage area in MH-17 and MH-18 by a given year. An operational goal would encourage much greater collaboration with the ADDs, other development programs, and even farmers. Moreover, the commodity program might even be encouraged to lobby government policy makers to help create more favorable economic environment for maize producers. The bottom line was that the World Bank Second Triennial Review believed that the critical intervention now was to put more emphasis on implementing research results of the DAR.[1] This team spent considerable effort to identify management devices to push the commodity research programs more in this direction.

The problem of getting research results out to farmers' fields for further feedback to scientists and ultimately for diffusion was a central feature of the MARE Project and the creation of an Adaptive Research Team for each of the eight ADDs. For a number of technical and other reasons explained elsewhere in this report, this organizational innovation did not work very well during the project's life, 1985-1992. However, the demand for the function they were designed to provide is still very great.

One test of the usefulness of an organization is its impact on resource allocation. Table 3 documents the changes in research resource allocation in 1991/92 and 1992/93, after the implementation of the priorities scheme. Roots and Tubers, Soils, and Maize got big increases in the last year. Some of the other allocations such as those to Rice and Wheat/Barley did not correspond to the ranking.

One important thing now would be to make the program criteria more operational, thereby internalizing the pressure on the research teams to get their new technologies out by collaborating more with ADDs, development organizations, and farmers. Also, the AGREDAT needs to continue to acquire the background information for better scoring and to make the commodity programs aware of how this is done. This would also influence operational criteria and provide more accurate subjective scoring by the experts over time.

The overall effect is that AGREDAT has made a big contribution to research planning, priority identification, and management decision-making.

Table 3: DAR Revenue Account - Estimates for 1990-93 by Functional Unit.

Functional Unit	Allocations 5/90 1990-91	4/91 1991-92	3/92 1992-93	% increase 90-91 vs. 92-93
Soils	84872	110334	153266	39%
Plant Prot. Serv.	45364	49900	58227	17%
Maize	116659	157490	218776	39%
Livestock	107407	134259	179041	33%
Pasture	35179	40456	49454	22%
Cotton	131084	150747	184276	22%
Seed Services	75926	94908	121290	28%
Rice	75763	94704	126292	33%
Groundnuts	74213	89056	113812	28%
Roots & Tubers	56655	70819	98375	39%
Other Grain Legumes	60868	73042	93346	28%
Sorghum/Millet	45537	52368	64015	22%
AGREDAT	40100	46115	56372	22%
Tree Nuts	49072	53979	62986	17%
Farm Machinery	29235	33620	41098	22%
Wheat/Barley	24586	29503	37705	28%
Coffee	50658	53191	62066	17%
Vegetables	39461	43407	51821	19%
Tropical Fruits	47272	54363	66454	22%
Oilseeds	31524	34676	40462	17%
Temperate Fruits	35756	39332	45894	17%
Irrigation/Drainage	26139	28753	33550	17%
Library	0	0	23337	

Source: Department of Agricultural Research, Ministry of Agriculture, 1992.

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ANNEX J

IMPACT OF MARE PROJECT ON NRCUs

ANNEX J
IMPACT OF MARE PROJECT ON THE NRCUs

The GOM's agricultural policy aims at a balanced and diversified production of food and cash crops to meet the country's requirements for food, foreign exchange, higher rural incomes and maintenance of natural resources. To achieve this objective the GOM places considerable emphasis on agricultural research. The research is organized by commodity groups; each commodity team is responsible for identifying the production constraints of its respective crops, and then to offer appropriate solutions.

Although the agricultural production constraints vary from one area of the country to another, and with the nature of crops or livestock to be raised, it is generally believed that production on small farms in Malawi is limited by the following:

- **Soil Fertility.** With the increasing pressure for continuous cropping and limited use of soil conservation and soil building practices, soil fertility has become a major constraint to increasing land productivity. Substantial yield increases do occur with the utilization of purchased chemical and organic fertilizers. But purchased fertilizer is very expensive and often difficult for smallholders to obtain. Some substitutes for purchased fertilizer, e.g., agroforestry practices and cereal-grain legume rotations, are being studied that show much promise.

- **Land holdings.** The average land holding is about one hectare per household. According to some estimates, farmers who cultivate 0.7 ha or less are generally not able to meet their food requirements. Those cultivating between 0.7 and 1.5 ha are not only able to satisfy their food requirements, but also have the potential to grow some cash crops.

- **Labor.** The average farm family size is about five, which could provide the equivalent labor of about two full-time persons. At the time of peak farming operations, such as land preparation, planting, weeding, harvesting etc., there is a scarcity of labor. This can limit a farmer's ability to perform all the necessary tasks of some farming systems that could result in increased productivity.

- **Cash/Credit.** The per capita income is estimated at only US$ 160 (Kydd, 1989). Low levels of working capital and lack of credit limit farmers' ability to purchase inputs often recommended as part of improved technologies. In 1986, only 16 percent of households received credit for seasonal inputs (DEVPOL, 1987 as quoted by Kydd). This has since increased to 30 percent in 1990/91.

- **Tools and Equipment.** Labor saving tools and equipment are seldom utilized. Generally speaking, they have not been introduced and popularized: the few that

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have been introduced are not properly utilized because of lack of maintenance and/or spare parts. Draft animals are hardly used in agricultural operations.

A. CEREALS

Maize, rice, sorghum, millet, wheat and barley are included in this NRCU. Maize is considered the country's most important food crop, and thus receives considerable attention at all levels.

Maize is a priority crop with almost all households in Malawi. In fact, this country is considered to be a nation of maize-growing smallholders. Over three-quarters of Malawi's cultivated area is planted in maize each cropping season, and per capita maize consumption is one of the highest in the world (Smale, 1991). The national aim is to attain and maintain self-sufficiency in maize requirements both at the household and at the national levels. The maize program is attempting to realize this objective by increasing yields per unit of land rather than through expanded hectarage. Several organizations, including CIMMYT, USAID and the Rockefeller Foundation, are assisting the maize program in realizing this objective.

The maize research program has made considerable progress over the past several years. It has released several dent hybrids such as MH12, MH15, MH16 and NSCM41, flint hybrids such as MH17 and MH18, and composite maize varieties such as UCA, CCA, CCC and CCD. The present average yields of maize in the country range from 2,000 kg to 3,000 kg for hybrid maize, and between 1,400 and 2,400 kg per hectare for the composites. This is a definite improvement over the unimproved varieties that yield only 880 to 1,300 kg per hectare. By following the recommended steps as outlined in the DAR's guide to agricultural production, it is possible for the smallholder farmers to increase further their maize yields.

The evaluation team also took time to visit the DAR's rice research station at Lifuwu. Rice is normally grown along the lakeshore, Phalombe Plain, the Shire Valley and areas around Lake Chilwa. The national aim is to fully utilize the irrigated land developed under the irrigation schemes for rice production, and to encourage adoption of high yielding varieties by the farmers.

The DAR presently recommends Blue Bonnet, IET 4094 (Senga), and IR 1561 (Changu) for the irrigated areas where two crops per year could be taken. The potential yields of these varieties range from 4,000 to 6,000 kg per hectare, which is almost twice the present average national yields. Faya 14-M-69 is recommended for the rainfed areas. In 1990/1991, 7,990 hectares were planted under improved rice varieties, while 24,851 hectares were planted under traditional varieties.

MARE's impact on Cereals NRCU are summarized below:

1. The project has trained or is funding the training of six individuals from the maize program. Two persons, one a plant breeder and an agronomist, have received Ph.D. degrees, and one individual each received an M.Sc. and a B.Sc. degree under the project.

Two other persons are presently completing Ph.D. degrees in plant breeding. From the rice program, two individuals received Ph.D. and seven received M.Sc. degrees (Four were trained under the project and the others under the predecessor University of Florida project). Thus, the MARE project definitely had a significant impact on strengthening the research capabilities of this NRCU.

2. The initial breeding and selection work was limited to improving the dent varieties. However, it was soon realized that the smallholder farmers were not adopting these varieties because of undesirable processing and storage characteristics. This led to intensified efforts to identify germplasms of flint varieties, an effort that soon paid off. By crossing the dent hybrids MH12 and MH16 with the flint population Posta Rica 8432, two new flint hybrids labeled as MH17 and MH18 were obtained. These two high yielding varieties have the flint characteristics of the local Malawi varieties, and appear at this time to be acceptable to farmers. These varieties have been approved by the Variety Release Committee, and the NSCM has multiplied enough seeds for distribution during the 1991/92 growing season. In the 1992/93 season, it is projected that over 1,200 tons of MH17 and MH18 will be available in ADMARC stores, which will be sufficient to plant 70,000 hectares.

3. Of all the NRCUs and their component programs, the maize team has worked most closely with the ARTs. It is not surprising since maize is by far the country's most important food crop. MARE-supported ARTs played a major role in testing the two new maize variety releases, e.g. MH17 and MH18, on the farmers' fields and eventually popularizing these varieties among the farmers.

4. Directly or indirectly, MARE project has definitely contributed to the development of MH17 and MH18 maize varieties.

5. The two flint hybrids, MH17 and MH18, were recommended for release in September 1990, and the seeds were made available for planting during the 1991/92 crop year planting season (November). This is a remarkable achievement by any standard.

B. GRAIN LEGUMES

The Food Legumes Program engages in research and technology development and exchange activities aimed at improving soybeans, pigeon peas, cowpeas, Phaseolus beans, groundnuts, chickpeas, lentils, Bambara nuts, Fava beans and other minor food legumes production and productivity in Malawi. Research activities on Phaseolus beans and Bambara nuts are carried out by Bunda College of Agriculture in cooperation with DAR and several international organizations. Research on other above-mentioned legumes are conducted by the DAR scientists based at Chitedze in collaboration with the various ARTs and international research centers such as ICRISAT, IITA, AVRDC, ICARDA and INTSOY.

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B1. Soybeans

Although soybeans have been grown in Malawi since 1909, their production levels in Malawi are still very low. The interest in soybean production has increased in recent years, both among smallholder farmers and estate growers because of an increase in producer prices and an active campaign launched by the GOM encouraging its production and utilization. The GOM's policy on soybeans as contained in the statement of Development Policies 1987-1996, is to encourage growing of this crop as a cheap source for: (a) human food and livestock feeds, (b) oil, and (c) cash income.

Research has indicated that soybeans are well-adapted to all agro-ecological zones of the country, although they prefer heavy soils with sufficient drainage. The MOA's *Guide to Agricultural Production* suggests that yields in excess of 2,000 kg can be obtained under good management. The ability of soybeans to fix atmospheric nitrogen, as much as 180 kg per hectare, is another desirable attribute for growing this crop, especially at a time when chemical fertilizers are becoming quite expensive. However, phosphorous and micro-nutrients may still be needed.

Although the Guide provides production recommendations only on mono-cropped soybeans, Malawian researchers have shown that maize-soybean intercropping has no adverse effects on maize yields, and that the soybean intercrop comes as a bonus to the farmer.

Soybean production in Malawi, however, remains constrained by the following: (a) non-availability of seeds of improved varieties, (b) lack of farmer awareness of improved production practices, (c) all presently recommended varieties require inoculation with rhizobia, and farmers lack an understanding of the importance of inoculation, (d) an underdeveloped rhizobium production, distribution and storage network, and (e) unattractive official producer prices.

Soybean breeding and selection have been limited to importation and evaluation of germplasm from several international centers. The primary selection criteria have been earliness, resistance to nematode, self-nodulation, high yields, etc. One variety, Ocepara-4 from Argentina, has shown good nematode resistance, while in terms of self-nodulation, Magoye, a variety from Zambia looks promising. Other varieties of high yield potential pending release are Duocrop and Santa Rosa. The Food Legumes Team has planned an elaborate and comprehensive research program on soybeans for the next five years.

B2. Pigeon Peas

The pigeon pea is traditionally grown as a smallholder crop, particularly in the southern region of the country. Pigeon peas can be grown in almost all types of soils, either in pure stand or in association with maize or sorghum. Its ability to utilize residual moisture during the dry season makes this an important crop in low rainfall areas. Its ability to fix atmospheric nitrogen coupled with its high protein content makes it a valuable smallholder crop both in terms of human food, feed and for soil improvement.

The factors that limit pigeon pea production in the country at the present time have been identified as follows: (a) lack of improved varieties, (b) disease, especially Fusarium wilt, and insect pests, (c) insufficient knowledge of its culture and management, and (d) low farm gate prices.

Under a FAO/UNDP initiative, a major pigeon pea research and development project has been started in 1989 at Makoka Research Station. The purpose of the project is to establish a research team complete with all the necessary infrastructure. For conducting research on all three crops of soybeans, pigeon peas and cowpeas, DAR has currently assigned only one breeder, one agronomist, and a soil microbiologist. This research group does not have a plant pathologist or an entomologist.

The grain legume program has made progress in alleviating some of the more important production constraints. Working in collaboration with ICRISAT, DAR has been able to release one wilt resistant pigeon pea cultivar, namely ICP9145. Several other ICRISAT lines have shown promise in terms of Fusarium wilt resistance and earliness.

B3. Cowpeas

This crop has been grown in Malawi for a long time. It provides a cheap source of quality protein in the human diet and animal feed. Malawians normally utilize the dry seeds of cowpeas, although green seeds and green pods are also used as vegetables. It is occasionally used as a green manure or as a fodder crop.

Most cowpeas in Malawi are grown in association with other food crops such as maize, sorghum, cassava, etc. The major cowpea growing areas are in the warmer and drier parts of the country such as Lakeshore, Bwanje Valley and the lower Shire Valley. Estimated yields of cowpeas on smallholder farms are about 250-600 kg per hectare, while yields of up to 2,500 kg have been realized under on-station conditions.

"Sudan 1" and "Selection 8" are the recommended varieties; however, the seeds of these varieties are not readily available. Several introductions have been made from IITA in recent years; these are being screened against Ascochyta blight disease, and for yield and earliness. The cowpea variety improvement program is being supported by Rockefeller foundation.

B4. Phaseolus Beans (Field or Dry Beans)

Field beans are grown practically all over the country, primarily in association with the maize crop, as a relay crop, and in the "dimba" production. The relay cropping is probably the best bean production system in the country as far as the yield is concerned. The average yields in the country stand at 250 kg and 700 kg per hectare for interplanted and pure stand beans. The total estimated area under beans and their production in Malawi are as follows:

Year	Area (Ha) cultivated	Production (Tons)
1985/86	71,097	22,398
1988/89	93,330	27,447
1990/91	115,554	38,511

As has been mentioned earlier, bean research in Malawi is conducted and coordinated by the National Bean Program located in the Crop Production Department at Bunda College of Agriculture. The National Bean Program participates in the MSU-led Bean/Cowpea Collaborative Research Support Program (CRSP) with the University of California at Davis as the lead institution. This collaboration has been instrumental in upgrading the country's bean research capabilities, including training of bean scientists. During its ten year of existence, it has directly trained two candidates at the Ph.D. and one at the M.Sc. level. It has also provided partial assistance in the training of one Ph.D. and one M.Sc. degree participants. CIAT, through its Southern Africa Bean Network, is also providing significant assistance to the National Bean Program.

Since its inception in 1969, the Program has released four dwarf (Nasaka, Sapelekedwa, Bwenzilawana, and Kamtsilo) and two climbing (Kanzama and Namajengo) bean varieties. The seeds of these varieties were given to the National Seed Company of Malawi (NSCM) in 1979 for multiplication and marketing. The company soon realized that the production and marketing of bean seeds was not a profitable venture, and thus it abandoned this activity after a couple of years. A viable system for the production and marketing of bean seeds is needed.

B5. Groundnuts

Groundnuts have been grown in Malawi since the 19th century. It is the second most important crop for smallholders, providing almost 25 percent of their agricultural cash incomes. At the national level, groundnuts are the fourth most important foreign exchange earner for Malawi after tobacco, tea, and sugar.

Groundnuts are grown over a diverse range of ecological zones, although plateau areas are the more important production areas. It is estimated that approximately 45 percent of all cultivated land, or roughly 130,000 hectares, is planted in groundnuts each year. The yield varies between 350 kg and 750 kg per hectare depending on variety and the region.

Groundnuts in Malawi are nearly always grown in pure stands. The recommended varieties are for oil crushing or confectionery purposes. Specific varieties are recommended for specific growing areas, such as the Chalimbana variety for plateau areas, and Malimba for the Shire Valley, Nkhata Bay, and the Lakeshore areas. All groundnuts planted in Malawi are improved varieties, however, the seeds planted by most farmers are of poor quality. There may be opportunities for collaboration with neighboring national research systems.

MARE's impact on the Grain Legumes NRCU is as follows:

1. The project did not provide any direct technical assistance to this NRCU, although some long and short-term training were provided through the project. The project also provided assistance to strengthen the Rhizobium production unit at the Chitedze station.

2. The NRCU is a large program involving many grain legumes. Besides the Chitedze and the Makoka Research Stations, research on certain crops are also carried out at the Bunda College of Agriculture, involving many other collaborators. Thus, hundreds of introductions are screened and tested annually on these localities.

3. Several of the food legume varieties and technologies developed on the station were tested on the farmers' fields by various ARTs.

C. LIVESTOCK NRCU

Livestock population in Malawi is estimated at 0.8 million cattle (of which only 4,000 are dairy cattle), 0.8 million goats, 0.13 million sheep, 0.2 million pigs and 14 million poultry. About 80 percent of smallholder farmers own livestock, and their contribution to farm income is estimated at 36 percent during the dry season and 44 percent during the wet season.

Despite these large numbers, Malawi is not self-sufficient in animal products as the production potential of different animal species has not been realized. For example, the average growth rate of Malawi Zebu is 0.20 kg per day, while the potential is at least five times that; the age at first calving is 40 months while ideally it should be 33 months. Milk yield of half-breed dairy cattle is only 5.8 kg per day. The bulk of the small ruminant population is comprised of indigenous animals that are raised mostly for meat production. Productivity of these animals is low; for example, goats have a birth weight of 2.1 kg, with a weight at 12 weeks of 8.2 kg, and mature weight of 25 kg.

The major constraints to livestock production in Malawi are poor nutrition and management, low genetic potential of local breeds, and inadequate disease and parasite control. Hence, the primary research foci of this NRCU are: (a) to improve livestock nutrition and management, and (b) to improve the genetic potential through breeding programs.

Pastures form the bulk of feed supply for ruminant livestock in Malawi. The total accessible grazing area is estimated at only 27,000 sq km, which is comprised primarily of natural grasses. A small proportion of accessible pasture is made up of improved pastures, mostly of Napier and Rhodes grasses containing a few planted legumes. The current productivity of both the natural and improved pastures is low because of inadequate soil fertility and poor management.

The Livestock NRCU is headed by a National Research Coordinator. In addition, the unit has one livestock breeder, three nutritionists, one animal production officer, and two

pasture agronomists. The livestock NRCU has developed a close working relationship with the Agroforestry CRT, and together they are trying to address the pasture soil fertility problems, and the year-round availability of quality animal feed.

Like the other two NRCUs described above, MARE did not provide direct technical assistance to this NRCU. However, the project provided long-term training to two participants from this unit at the M.Sc. level, and short-term training to several other staff members. MARE thus has upgraded the research capabilities of this particular unit.

This unit, in collaboration with the Agroforestry CRT and the ARTs, was able to test a few forage species on the farmers' fields. It utilized the serviees of the Lilongwe ART's socioeconomist to analyze socioeconomic data.

D. ENGINEERING AND LAND HUSBANDRY NRCU, AGROFORESTRY CRT

Agroforestry work began in Malawi during the early 1980s involving the Forestry Department, Bunda College, Malawi Tobacco Research Authority, and the Land Husbandry Branch of the Department of Agriculture. Despite commendable efforts by all parties, it soon became evident that further progress was not possible without substantial investments in personnel, training, equipment, and a sound research base for generating appropriate technologies.

Recognizing these limitations, the GOM formed a National Agroforestry Steering Committee in 1984 as the policy-making body for agroforestry in Malawi, and the MOA was given the coordinating responsibility for all in-country agroforestry efforts. To assist in this role, the MOA established an Agroforestry Commodity Research Team (ACRT) under the DAR. The overall goal of the team is to improve agricultural sustainability and food security for Malawi's farmers, and to alleviate land-use pressures on the natural resource base. The team's primary function is to develop appropriate technologies through research, and to test these under site-specific smallholder conditions with assistance from the ART and the ADD staff.

The team leader of the ACRT recently joined ILCA for one year, but it is unlikely that he will return to DAR. There are two persons on the team with M.Sc. degrees, one in agronomy and one in forest ecology. A US technical assistant from WSU has been with the team since 1986. His contract under MARE ended in March of this year; presently he is funded by the Rockefeller Foundation. There are seven technicians working in the team on a permanent basis, and three more on a temporary basis; there are 30 casual workers on the station, and 16 more at various locations.

The agroforestry program is in the stage of farm testing promising alley crop systems. They have just switched from Leucaena to Cassia spectabilis and Gliricida sepium to avoid susceptibility to termites and browsing during establishment. There is only one year of tests of the adequacy of these two exotics substituting into the excellent Leucaena-maize system developed. This system had shown substantial potential for organic matter to substitute for

fertilization. This Leucaena system is presently being promoted in the 1992/93 *Guide to Agricultural Production*, the official GOM recommendations. Moreover, there has been very active involvement with farmers through various NGOs and other development programs. The most direct and systematic extension contact is with the Land Husbandry units in the ADDs. This alley cropping technique has substantial potential to reduce chemical fertilizer requirements on small farmers' fields.

The system does require increased labor to prune the branches so that the maize density can be increased, Seven to nine person-days/ha are required for this operation 10 to 14 days after planting. The branches are then placed between the rows of maize. The leaves serve as organic matter and the wood is used for firewood.

Acacia albida has a recognized effect among farmers on cereal yields. Farmers will protect seedlings but systematic planting is unknown. The agroforestry program has developed a system of planting and thinning the Acacia. The program is working with the National Program of Forestry to diffuse this system and Acacia seedlings. The Forestry Department has 270 nurseries across the country.

Agroforestry research activities have laid a sound foundation for soon making a significant impact on agricultural sustainability and food security in Malawi. Management recommendations have been developed for several key technologies. These are now undergoing on-farm testing and pilot extension efforts in different ecozones of the country. Outlined below are a brief description of some of these technologies:

D1. Alley Cropping

Research in Malawi has shown that maize yields can be maintained at 2 to 3.5 tons per hectare under alley cropping with Leucaena on nutrient poor or depleted soils in the absence of inorganic fertilizers. This technology seems to provide better than half of the recommended rates of nitrogen for the production of maize. In phosphorus deficient soils, addition of 40 kg of phosphate per hectare every other year can further boost yields, for example from 3 tons to 5.5 tons per hectare. Thus, this technology could substantially reduce the application rates of costly imported inorganic fertilizers, and attain substantial yield increases, especially in maize.

In addition to improving crop yield and soil fertility, these alley cropping trees and shrubs could provide nutritious animal feed and much needed fuelwood. Susceptibility to termites and browsing during establishment are possible constraints to the widespread diffusion of this technology. Therefore, other species such as Cassia spectabilis and Gliricidia sepium are being tested for suitability as replacements for Leucaena.

D2. Acacia Albida (Faidherbia Albida)

These are fast growing leguminous trees indigenous to Africa. The distinctive feature of these trees is that they grow and produce a lot of leaves during the dry season, and shed them at the beginning of the rainy season. Thus, the crops planted under these trees at the

onset of rains are not affected by their shade. On the contrary, they provide shade and fodder when most other trees have no leaves. Research conducted by the ACRT has established that the yield of local maize grown under these trees, which is a common practice with Malawian farmers, could be maintained at 2 to 3 tons per hectare. Supplemental feeding trials using the trees' pods showed significant weight gains in young sheep during the dry season. These findings confirm the value that the Malawian farmers attach to these trees.

D3. Fodder Banks

These are generally small plots of high-yielding plants with nutrient-rich foliage and/or pods that could be used as supplemental livestock feed. They also yield considerable amount of fuelwood and stakes/poles. Leucaena alone or intercropped with alleys of Napier grass are currently being recommended.

D4. Contour Grass Strips and Hedgerows

Cultivation of hillsides often leads to serious soil erosion and water run-off problems. Grass strips planted on the contour along with suitable hedges of leguminous or fruit trees often alleviate these problems. Cassia and Gliricidia are the shrubs recommended for this purpose. Vetiver grass and Napier grass also have shown promise.

D5. Multi-purpose Trees

Systematic and scattered planting of MPTs on farms, homesteads and boundaries can generate important sources of food, fodder, shelter, fuelwood, poles and income for a family. The program has compiled a list of useful trees that the smallholder farmers could consider planting for the described purpose.

For all practical purposes, the agroforestry work in Malawi began with the initiation of MARE Project. Therefore, most of the accomplishments in agroforestry are a direct result of MARE.

The Agroforestry CRT's major accomplishments are as follow:

1. The team has collected a total of 163 species, accessions, or provenances of trees. Germplasm collected in Malawi include 67 indigenous species/provenances, and 33 that are exotic or naturalized. All these species are presently at various stages of screening.

2. A total of 22 species are being tested on-farm, including Vetiver and Napier grass. A further 21 species are now recommended as fast-growing MPTs in the Guide to Agricultural Production.

3. Research-based management practices have been developed for alley cropping, interplanting trees with crops, boundary and homestead planting, live fencing, fodder banks, contour strips, etc.

4. As far as impact on smallholder utilization of agroforestry techniques are concerned, these technologies will be published in the 1992/93 *Guide to Agricultural Production*. Various GOM agencies, donor organizations and NGOs are utilizing the team's recommendations in extending these technologies to the farm communities. In addition, the ACRT is providing them with planting materials and advice on an as-needed basis.

5. Concerning the ACRT's impact on the smallholder agricultural production, it may be stated that the dissemination of agroforestry technologies has just begun, and it is too early to demonstrate any impacts. If research results are any indication, one could hope to see significant impacts of agroforestry technologies at the household level in a few years time. It is our understanding that monitoring and evaluation of these kinds of impacts will be an integral part of the upcoming USAID's Agroforestry Extension Project under the Agricultural Sector Assistance Program (ASAP).

6. Agroforestry technologies have been evaluated economically for smallholder farmers. This includes alley cropping maize with Leucaena. These have shown significant positive benefits over traditional cropping practices.

E. HORTICULTURAL NRCU

This unit includes research on fruit crops, tree nut crops, vegetables, roots and tuber crops, and spice and herb crops. The research on all these commodities are located at the Bvumbwe Agricultural Research Station located near Blantyre. Malawi is a country that offers a variety of agroclimatic conditions where many of the above-listed horticultural crops could be grown for profit. These crops are of high value in terms of nutrition and income generation potential for smallholders.

Despite its high local and export market potential, horticultural industry in Malawi is only poorly developed. The present low level of production, consumption and export tends to down play their importance to the nation. The smallholder farmers usually grow untested, unselected fruit trees that receive little care and attention. Improvement in the production practices of fruits and vegetable crops could potentially earn foreign exchange through exports to neighboring countries and to Europe during the winter season.

The evaluation team found the scientists at the Horticultural Research Station motivated and enthusiastic. The station has excellent research facilities and well qualified researchers and staff; but it is our understanding that the station is not productive to its full potential because of lack of operational funds, and a lack of appreciation on the part of the policy-makers for horticultural crops.

MARE's impact on the Horticultural NRCU is as follows:

1. MARE provided one long-term TA position for six years (served by two expatriate advisors for 2.5 years and 3.5 years, respectively). These two TAs have made significant contributions in strengthening the entire horticultural research program. Some of the more specific impacts could be outlined as follows:

- The MARE TAs carried out the research activities of other Malawians when they were in degree training in the US.

- They established contacts with other organizations for training purposes and for the importation of plant materials of citrus, pecans, coffee and apples. In addition, short-term consultants were made available to work on coffee berry disease and Panama disease in bananas. The recommendations made by these consultants are now being implemented.

- The program benefitted a great deal from both long- and short-term overseas training of many of the researchers. Two individuals received Ph.D. degrees, two participants received M.S. degrees and four others received certificate level training under this project.

- The TAs conducted many short courses and provided on-the-job training for the station staff. The impact was most strongly felt in the areas of data management and analysis, and word processing, including graphics.

- The project purchased computers and software, and equipped the laboratory with many essential items. The library has been expanded, and a new irrigation system has been ordered.

The above list could go on; however, the most important part was the quality of the TAs that the MARE project provided. This made the real difference. They assisted with production and marketing surveys, and initiated on-farm trials involving many horticultural crops.

2. Several fruit and vegetable crop varieties were selected for on-farm testing. However, since the ARTs were overwhelmed with the on-farm trials of cereals and other food crops, they were unable to accommodate any requests from the Horticulture NRCU. Another problem is that the ARTs do not have any horticulturist on the teams. However, the horticultural scientists, in collaboration with the ADDs and the farmers, conducted many on-farm trials themselves.

3. Improved varieties of mango, banana, pineapple, pawpaw, casimiroa, edulis, guava, avocado pear, citrus, apple, plum, pear and strawberry have been released to growers, together with recommended production practices based on research-proven data. These include pest management, plant nutrition, plant population, method and time of pruning, and soil moisture conservation measures. Furthermore, local collections of mango and banana were made. The list of all the recommended varieties has been attached to this annex.

4. Implementation of on-farm trials and demonstration plots has been incorporated in all horticultural commodities. The demonstration trials that have been initiated at Extension Training Centers and on farmers' fields at numerous sites resulted in improved linkages with the extension staff. This researcher-extension staff-farmer interaction has led to increased

production of mango, citrus and avocado by the smallholder in the Liwonde ADD; cabbage, tomato, apple and peach production in Blantyre and Lilongwe ADDs, and indigenous vegetable production in the Ngabu ADD (Braunworth, End-of-Tour Report).

5. Limited market surveys and analyses have been conducted to identify farmer problems and cost of marketing of banana and tomato. Based on this, a framework for data collection has been developed which can be adapted to other perishable fruit and vegetable crops (Braunworth, End-of-Tour Report). Future research intends to focus on an assessment of post-harvest losses, and generation of appropriate technologies that will reduce post-harvest losses and enhance their marketability. A project proposal to this effect has been developed under SADCC's umbrella, and submitted to the donor community for funding consideration.

6. The major constraints to farmer adoption of improved horticultural practices are primarily two-fold: (1) a lack of knowledge on the use of inputs and marketing problems, and (2) a lack of improved planting materials. In cases where the researchers distributed planting materials and technical advice, farmers' response have been very positive. The constraints appear to be in the system itself; horticultural crops in the country are viewed as low priority crops, and hence suffer from a lack of interest from the extension service personnel.

7. There has been a substantial impact of MARE on smallholder agricultural production. A few of the interventions are described below (Braunworth, End-of-Tour Report):

- An integrated approach to control coffee berry disease utilizing cultural practices, resistant varieties and fungicides has been developed. This will allow the smallholder to maintain a cash income from coffee production.

- Intercropping trials of maize and beans with coffee were designed and initiated in Bvumbwe. These prototype trials will be the basis for developing recommendations for the production of a cash crop along with a food crop.

- Intercropping trials of cassava with maize, and sweet potatoes with maize, are aimed at developing recommendations for smallholder food security during the periods of drought.

8. The Horticultural NRCU has illustrated the nutritional and income potential of several fruit and vegetable crops. The table attached to this annex is from: "High Impact Horticulture Assistance Program: A Proposal Prepared by Horticultural NRCU", (May 1992). It shows that a smallholder could supplement his/her income by MK 1,300, MK 212, MK 439 from only 20 trees of mango, tangerine or peach, respectively. Vegetables can provide in just a few months time, gross incomes ranging from MK 7,480 to MK 40,590 per hectare, which is well above input costs. The gross value of cassava and sweet potatoes per hectare is close to MK 6,000. In addition to monetary income, the nutritional values of these crops to smallholder families cannot be overemphasized.

F. COMMENTS/ SUGGESTIONS ON NRCUS

1. Maize is an important crop in Malawi, and it should receive its fair share of attention. However, too much dependence on one crop may create a difficult situation at times, as drought has brought about this year. Crop diversification, one of MARE's objectives, should continue to be emphasized at all levels. The difficulties for low-income smallholders to diversify are well understood and need to be addressed.

2. Improved varieties and technologies are important to increase per-unit production, but without water, nothing can be harvested. Irrigation should be given higher priority. Malawi is fortunate to have vast water resources; these should be properly utilized. Rather than developing large irrigation projects, small manageable schemes involving a small number of smallholder families should be considered. In some areas, small catchment areas to hold surface rain water, should be promoted. Water harvesting technologies successfully developed in many semi-arid countries could be adapted and utilized in Malawian situations. Irrigation will also permit double cropping in many parts of the country.

3. National fertilizer recommendations are presently made for the entire country (see the annual *Guide to Agricultural Production*). These recommendations should be fine-tuned for different regions, based on soil testing and multi-locational trials.

Research should be conducted to increase fertilizer use efficiency. Fertilizer will bring maximum returns only after the best crop management practices have been utilized.

4. Diammonium phosphate (DAP) is recommended frequently in Malawi. Crops usually respond well to DAP for the initial 2-3 year period, but after that yields drop, primarily due to build-up of soil acidity. Researchers are encouraged to study the experience with DAP use in other countries, especially in Kenya, before recommending its continued use in Malawi.

5. The value of crop rotation in agricultural production can not be overemphasized, yet the Malawian researchers and producers do not seem to take full advantage of this practice. Through training and demonstration, the grassroots level extension agents and the farmers should be convinced of its usefulness.

6. Production and distribution of seeds, with the exception of hybrid maize, appears to be a problem in the country. A solution for this should be found and implemented.

APPROXIMATE YIELD OF IMPROVED VARIETIES, FARM GATE VALUE, AND NUTRITIONAL CONTRIBUTION OF HORTICULTURAL CROPS TO SMALLHOLDERS IN MALAWI

Crop	Expected yield (kg/tree or ha)	Measurement unit for yield	(Farm-gate gross product value) (MK/kg)	(MK/tree)	(MK/ha)	Nutritional Contribution (Vitamin, or ANV@)
Mango (Fiberless)	65	1 tree	K1.00	K65.00	K8,024.69	Vit A
Tangerine ##	53	1 tree	K0.20	K10.61	K2,948.15	Vit A, K
Sweet Orange ##	29	1 tree	K0.20	K5.83	K1,618.89	Vit C, Vit A, K
Banana (cavendish)*	19	1 tree	K0.35	K6.69	K7,427.78	Vit C, K, Mg, Na, P
Cashew	20	1 tree	K1.50	K30.00	K3,703.70	
Peach ##	22	1 tree	K1.00	K21.97	K6,101.85	Vit A, K
Apple ##	5	1 tree	K3.00	K15.00	K7,500.00	P
Plum ##	8	1 tree	K1.00	K7.83	K3,913.75	Vit A, K
Sweet Potato-fresh **	23443	1 ha	K0.25	n/a	K5,860.81	Vit C, Vit A, Carbohydrates
Cassava-fresh ***	3704	1 ha	K0.30	n/a	K1,111.10	Vit C, Starch
Cassava-fresh #	20000	1 ha	K0.30	n/a	K6,000.00	Vit C, Starch
Tomato-dry season ##	37430	1 ha	K0.20	n/a	K7,486.00	101 ANV (Vit A&C)
Tomato-rainy season ###	27480	1 ha	K0.99	n/a	K27,205.20	101 ANV (Vit A&C)
Onion $	33600	1 ha	K0.25	n/a	K8,400.00	79 ANV (Tops-Vit A)
Cabbage-dry season ##	68370	1 ha	K0.40	n/a	K27,348.00	120 ANV (Vit C)
Cabbage-dry season ##	73800	1 ha	K0.55	n/a	K40,590.00	120 ANV (Vit C)
Chinese Cabbage ##	48500	1 ha	K0.35	n/a	K16,975.00	180 ANV (Vit A&C)
Amaranthus leaves						204 ANV
Cassava leaves						870 ANV

* = price per kilogram assumes the farmer will market the fruit himself, and is the price expected after marketing costs (not production) have been met. (Based on DAR survey data for Masanbanjati)
** = prices are at farm gate offered by KK Miller to farmers, 1992.
*** = yield is with mealy bug problem and estimated price at market.
\# = yield is without mealy bug problem and estimated price at market.
= estimated wholesale price at market.
= prices based on survey data of the Bvumbue market, wholesale prices in February 1991.
@ = average nutritive value per square meter, which considers protein, fiber, milligrams of Ca, Fe, cartene, and Vit C.
see Yamaguchi (1983), World Vegetables, Principles, Production, and Nutritive values.

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RESEARCH ACHIEVEMENTS AND TECHNOLOGY ADOPTION

Improved varieties of mango, banana, pineapple, pawpaw, Casimiroa edulis, guava, Avocado pear, citrus, apple, peach, plum, pear, and strawberry have been released to growers together with recommended practices based on research-proven data e.g. pest management, plant nutrition, plant population, method and time of pruning, and soil moisture conservation practices. Furthermore, local collections of mangoes and bananas were made. On-farm trials on mangoes in Mangochi, bananas in Masambanjati, tangerines in Mwanza, and apples in Ntcheu were conducted.

Mango: Tommy Atkins, Haden, Kent, Irwin, Keitt and Davis Haden: These varieties were introduced from the University of Florida, USA and are giving high yields of quality fruit in the mango growing areas. Yields of up to 100kg/tree for 10 year old trees have been obtained in Malawi. The quality is excellent for both the local and the export markets.

Banana: Williams and Kabuthu: The variety Williams is a tall Cavendish banana introduced from RSA. It is a high yielder producing up to 50,000kg/ha under Malawian conditions and the quality is very good. Kabuthu variety is a local selection which is being grown commonly by smallholders. Yields of up to 40,000kg/ha have been achieved in the banana growing areas. A collection of local dwarf and tall Cavendish bananas has been made and evaluation of their performance continues. The dwarf and tall varieties collections are composed of 20 and 15 entries respectively.

Pineapple: Smooth Cayenne and Queen: These varieties were introduced from RSA and are being grown extensively in the country. Smooth Cayenne produces the highest yields in Malawi i.e. 50,000kg/ha and is produced for both the fresh fruit market and processing. The yield for Queen is low (20,000kg/ha) and is produced mainly for the fresh fruit market.

Avocado Pear: Hass, Mayapan, Fuerte: These varieties were introduced from RSA and have good quality characteristics i.e. good fruit size, rough skin, no fiber and long distance transportation and storage properties. They are also good for both domestic and export markets. Yields of up to 50, 60, and 70 kg/tree have been obtained for Hass, Mayapan, and Fuerte respectively.

Citrus: Oranges (cv. Valencia Late, Jalia, Washington Navel, Premier): Tangerines (cv. Mwanza tangerine): Lemon (cv. Eureka and Villa Franca): Lime (cv. Tahiti and West Indian): Grapefruit (cv. Duncan and Marsh Seedless). Yields of up to 50, 60, 90, 100kg/tree have been obtained for oranges, tangerines, grapefruit, and lemons respectively.

Apple: Anna, Dorsett Golden and Ein Shemer. These are low chill requirement cultivars introduced from the University of Florida and Israel. They are high

yielding and with fruit quality close to the imported varieties. Yields of up to 50, 56, and 60kg have been achieved for anna, Dorsett Golden and Ein Shemer respectively in the 5th year of production.

Peach: Flordared, Flordagrande. These are low chill requirement varieties introduced from the University of Florida and Brazil. They produce high yields of high quality fruit. Fruit yields of up to 30, 50, 40 and 60 have been achieved for 5 year old trees of Flordared, Flordagrande, and B respectively.

Plum: Santa Rosa, Harry Pickstone, Ruebenel and Satsuma. These are Japanese low chill requirement cultivars introduced form RSA and the Republic of China. They produce high quality yields of good fruit characteristics. Yields of up to 50, 40, 30, and 20kg/tree have been achieved for 5 year old trees of Santa Rosa, Harry Pickstone, Ruebenel, and Satsuma respectively.

Pear: Hood and Flordahome. These two varieties have a low chilling requirement and were imported from the University of Florida. They produce high yields of good quality fruit. Yields of up to 50 and 30kg/tree have been achieved for Hood and Flordahome respectively.

Strawberry: Selecta, Parfaite, Cambridge Favourite. These varieties were introduced from the United Kingdom, RSA, and France. They are long-day or neutral varieties and produce a good number of runners and also yield good quality fruit. Yields of up to 50,000, 60,000 and 40,000kg/ha have been achieved with Selecta, Parfaite and Cambridge Favourite respectively.

Despite the availability of the improved varieties and improved production technologies, the impact on the smallholder farmer is very limited. The poor adoption rates are attributed to:

a) high cost of inputs
b) weak linkage between the horticulturists, extension staff and farmers
c) inadequate operating funds for both research and extension activities
d) shortage of qualified human resources
e) lack of credit facilities for fruit growers
f) inadequate nurseries to provide seedlings
g) lack of post-harvest handling and processing facilities
h) absence of organized marketing channels

ANNEX K

ADAPTIVE RESEARCH PROGRAM PROFESSIONAL STAFF

ANNEX K
ADAPTIVE RESEARCH PROGRAM PROFESSIONAL STAFF
(BY POST - MAY 1992)

	NARCU	ADD:								
		Karonga	Mzuzu	Kasungu	Salima	Lilongue	Liwonde	Blantyre	Ngabu	Total
Socioeconomist	0	1	0	1	0	1	0	0	0	3
Agronomist	0	1	1	1	1	1	1	1*	0	7
Total	0	2	1	2	1	2	1	1	0	10

NOTE: All ARP professional staff are males.

* This post may soon be open as its current holder has been nominated for the post of Agronomist NARCU.

Of six M.Sc. agronomists trained via MARE, three are currently in ART, two have resigned and are employed within the Malawian agricultural sector[1], and respectfully, one passed away. Of four M.Sc. agricultural economists trained via MARE, one remains in an ART while three have resigned and are employed within the Malawian agricultural sector[2].

[1]One seconded to Horticulture CRT within MOA; one at Small Holder Sugar Corporation.

[2] One at USAID; one at ODA; one at Estate Extension.

ANNEX L

FACTORS INFLUENCING ART/CRT COLLABORATION

ANNEX L
FACTORS INFLUENCING ART/CRT COLLABORATION

(1) Lack of Incentives and Differing Channels of Authority

There were less professional incentives than apparently needed to stimulate collaboration, compounded by the fact that while both programs are NRCU and are responsible technically to the DAR, ART reports administratively to the PM at the ADD. As they are deployed at the ADD level, much of their professional interaction occurred and practical needs were met at that level.

(2) Lack of Logistical Support and Transport

If the desire to collaborate existed, then problems of logistics and transport were likely to have occurred making collaborative planning and implementation activities very difficult.

(3) Differing Research Focus

If the above problems were solved, it is likely that issues of research priorities and subsequent trial design emerged.
A series of socioeconomic surveys were carried out at the ADD level to determine research priorities. Starting with the collection of Background Information Survey Data (BIS) based on review of secondary data, the process then moved to implementation of an Informal Survey (IFS). IFS provided direct input from farm families in order to identify researchable constraints to farmer productivity. CRT were to be involved at this step, yet it is not clear to what extent they were involved. If shelf technology existed to address identified constraints, it appeared to have been utilized. If not, a Formal Diagnostic Survey was implemented to determine methods for removing/reducing the constraints. A formal report of relevant findings was to be provided to the appropriate CRT.

The input from the various regionalized socioeconomic surveys was utilized at the ADD to determine research priorities and to design subsequent on-farm trials. The extent to which the CRTs were involved in this process is not clear, nor is it clear that the ART and CRT priorities were the same. Further, it appears that the organization of collaborative research at this stage encountered significant problems of agreeing on objectives, hypotheses to be tested, responsibilities of collaborating parties, and types of analyses to be performed (Gillard-Byers, 1989, Final Report).

Some of these problems are highlighted as summarized in project documentation of ARP on-farm research methodology.

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The methodology of ART agronomic trials evolved over time. Earlier trials had been quite similar to research station trials in order to meet the perceived need to maintain acceptable statistically sound results.

> ...this basic methodology evolved to the frequent use of single farm replications and number of treatments limited to six. This allowed some measure of management or micro changes in physical environment. As such is represented, to some extent, the inherent variability in field conditions over which the technology being tested must be both biologically responsive and economically sound. Also the plots were embedded into gardens of similar crops so the operations done by the farmer could be an integral part of the farmer's garden. These modifications allowed for more farmer interaction, understanding, and involvement with the trials as well as an opportunity to better identify the operational constraints. However, from an operational perspective most of the management operations were still under the supervision of the research team. Essentially the farmer's contribution was mainly in land preparation and weeding. The planting, fertilizing, harvesting and other activities were still mostly controlled by the research team, with a continued concern for statistical soundness. (Tinsley, Final Report, 1991, p. 16.)

(4) Lack of ART Professional Staff

The ART were seldom, if ever, operating with their full complement of staff. This apparently influenced the number and type of collaborative research trials they were able to successfully undertake. There simply was not the person-power to respond to the different CRT needs for adaptive research.

ANNEX M

METHODOLOGY AND ROLE OF ADAPTIVE RESEARCH PROGRAM

ANNEX M
METHODOLOGY AND ROLE OF THE ADAPTIVE RESEARCH PROGRAM

The source for the following information is: Adaptive Research - Technical Assistance Economist - End-of-Contract Report, T. Gillard-Byers, July 1989.

The following is directly quoted from pages 5, 6, 7 and 8 of this report.

"During 1986, a meeting was held by Malawian agriculturalists and administrators. At this meeting guidelines for the ARP were drafted. (Secretary of Agriculture, 1986)

The Malawi philosophy toward Adaptive Research resulted in the following goals:

I. Strengthen the Research-Extension linkage.
II. Improve on the low adoption of technologies.
III. Facilitate and direct research toward priority problems faced by farmers.

The methodology for achieving these goals was formulated during the same meeting. Subsequently, the Controller of Agricultural Services (CAS, NRDP) issued a directive which included the methodology:

A. Adaptive and Commodity Research Teams belong to a common pool and should plan and execute the research programmes jointly. Emphasis should be placed on joint participation in development of both groups.

B. Research Programmes development will proceed as follows:

1. Surveys will be the first phase of programme development. These surveys do not necessarily have to be undertaken in the field. The surveys will be done by both Adaptive Research Teams and the Extension staff and a report of each survey will be produced and discussed by Adaptive Research Teams (ARTs), Commodity Research Team (CRTs) and ADD Management.

2. Analysis, identification of priority problems and their alternative solutions will be done by the Adaptive Research Team, Commodity Teams and ADD Management.

3. The outcome of the above joint participation in the diagnosis phase will be the identification of appropriate recommendation immediately offering solutions to the problems identified or action to be undertaken by research as follows:

a. If technology apparently offering solution to an identified problem is readily available for use, Adaptive Research Team and Extension should take it up to the farmer.

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b. If technology is available but further research is required, then the Adaptive Research Team should take it up for fine tuning or adaptation on farmers fields with Commodity Research backup.

c. If technology is not available at all, then the Commodity Research Teams should take the lead in designing the on station trials with the Adaptive Research Team backup.

4. All research work will be based on the findings of the survey.

C. The staffing of the Adaptive Research Team at the ADD and their mode of operation will be as follows:

a. The staffing of the Adaptive Research Programme will be coordinated through/by the Divisional Agricultural Officer at the ADD Management.

b. The Adaptive Research Team will be composed of an Agronomist and Socioeconomist who will be placed at the ADD Headquarters.

c. At the field level, the Adaptive Research Trials will be implemented by the T/A (Extension) who will be supervised by the Development Officer and that a Technical Officer (Research) who will be based at the Rural Development Programme Headquarters will provide constant assistance to the Development Officer.

d. Where an Adaptive Researcher or Commodity Researcher is qualified to do Commodity or Adaptive Research, he/she will be allowed to do so. However, any researcher will do Adaptive Research as long as he/she is identified capable." (Secretary for Agriculture, 1986)[1]

"The Adaptive Research Program was intended to fill a gap which appeared to exist between the farmer, CRTs, Extension and administrators. In an attempt to carry out the mandate of the Program the following specific objectives were developed:

- From the range of available technical research results, select and if necessary adapt, components identified as appropriate to the immediate needs and conditions of local specific groups of farmers.

- Feed back to appropriate Commodity Research Teams unsolved technical problems identified as important to local farmer development.

- Link research closely and continually to extension, drawing extension personnel and farmers into the technology development process.

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[1] Reference given as: Ministry of Agriculture, Principal Secretary. (1986). Guidelines of the Malawi Philosophy and Methodology of Adaptive Research. Letter Reference No. 44/5/1/81, Malawi, Lilongwe.

- Make information available to relevant institutions (e.g., those dealing with extension, input supply, credit, marketing, etc.) by describing institutional and infrastructure problems farmers face in specific areas of the country.

The main functions of the ARTs under the direction of the ARPCU are the following:

- To collect information on the different farming systems in the ADDs which will be used to formulate relevant Adaptive and Commodity Research Programmes required to meet national and farmer goals.

- To undertake on-farm Adaptive Research Trials.

- To provide an effective link between research and extension through: (1) direct involvement of Extension personnel in the programmes of Adaptive on-farm trials including: (a) problem identification, (b) trial content and design, (c) trial management, (d) trial evaluation, (e) recommendation formulation, and (2) continual dialogue with CRTs concerning potential technological solutions and applied research thrusts."

ANNEX N

VISUAL AIDS UNIT STAFF AND QUALIFICATIONS

ANNEX N
VISUAL AIDS UNIT STAFF AND QUALIFICATIONS

Agricultural Development Division

Position Qualification	Karonga	Lilongwe	Mzuzu	Liwonde	Blantyre	Kasungu	Salima	Total
VOA (Diploma)	1	1	1	-	1*	1	1*	7
Photographer (Certificate)	1	1	1	1	1	1	1	8
Puppeteer (OJT)#	2	2	2	2	2	2	2	16
Graphic Artist (Certificate)	-	1	1	1	-	-	1	5
Printer/Press (Cerficate)	-	-	1	-	1	1	-	3
A V Maintenance Asst. (Cerficate)	1	1	1	1	1	1	1	8
Mobile Van Operator (OJT)#	2	2	2	2	2	2	2	16
TOTAL	7	8	9	8	7	8	8	63

* Acting.

Provided on-the-job training only.

ANNEX O

EXTENSION AIDS BRANCH MATERIALS PRODUCTION

ANNEX O
EXTENSION AIDS BRANCH MATERIALS PRODUCTION

In addition to the substantial material production discussed in the body of the report, average yearly EAB production follows the pattern outlined below. These figures do not include production at the ADD level:

- **Radio Programs:** About three-quarters of an hour of agricultural radio program broadcasting per day (six programs at 252 hours of broadcasting time per year).
- **Bulletins:** 14,500
- **Handbook Sheets:** 21,000
- **Posters:** 6,300
- **Slide Sets:** 5,448 currently in library
- **16 mm Film:** 4
- **Video:** 8 (equipment on order)

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ANNEX P

MZUZU ADD PRESENTATION PLAN - ACACIA ALBIDA

MZADD PRESENTATION PLAN

SUMMARY:
- **Physical Character**
- **Fodder Production**
- **Integration**
- **Nursery Establishment**
- **Planting/spacing**
- **Protection**

PURPOSE:
Explain the benefits of *Acacia albida* to smallholder farmers.

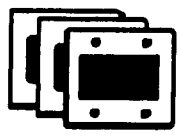
OBJECTIVE:
To improve the productivity of smallholder farmers by presenting the steps necessary for *Acacia albida* planting and establishment.

AUDIENCE:
Selected MZADD men and women farmers.

Methods:
Presentation /demonstration.

Lesson Time:

MATERIALS NEEDED:
Seeds, planting materials, AUDIO/VISUAL SUPPORT



INTEGRATION OF ACACIA ALBIDA ON SMALLHOLDER FARMS

The *ACACIA albida* tree helps improve soil structure and nutrient status. The tree also provides important shade and abundant high quality fodder during the dry season.

The use of *Acacia albida* will alleviate problems associated with:

** Declining crop yields
** Low soil fertility
** Escalating costs of HAF and organic fertilizers .
** Fuelwood and fodder shortages

PHYSICAL CHARACTERISTICS:

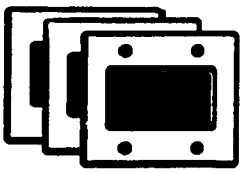
A. The tree is a large leguminous tree regarded as the **fastest growing tree in Africa**.

B. Mean maximum height is 25m, with girth of 5m and a canopy of 100-150 m2.

C. The leaf mulch and partial shading of the branches also **reduces heat stress** and **evapo-transpiration** that affects grain yields.

D. **Millet and sorghum yields** under the tree are **50-250% higher** than adjacent areas. Continuous millet and sorghum cultivation beneath the trees if possible without reduction in yields or additions of fertilizers.

Introduce visual aids: slides/video



E. **Maize yields are 100-250% higher** under the trees.

F. The tree does not compete with annual crops for soil water as it does not transpire during the crop growing season.

G. The tree's shade and abundant browse during the dry season attracts animals which further enrich the soil with their urine and dung.

H. The tree also supplies significant amounts of firewood.

FODDER PRODUCTION:

A. *Acacia albida* provides a significant amount of high quality feed during the dry season.

B. At an optimum density of 25-40 mature trees per hectare, the trees provide more fodder value per unit area from pods alone, than any other local forage. This density of trees provides between 2,500 and 4,000 kg/ha.

INTEGRATIING ACACIA ALBIDA INTO EXTENSION PROGRAMS

GROUP DISCUSSION TO SHARE FARMER INPUT/INFUSION

Site and Farmer Selection.

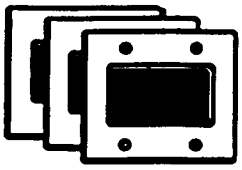
A. *Acacia albida* can occur in several different environments within the Mzuzu ADD.

B. Bolero and Chintheche areas are best for initial trials.

C. Both women programs and farmer clubs will be involved.

D. At each site, 10 farmers will be chosen:
   * 6 women and 4 men.

Demonstration or video/slide presentation



NURSERY ESTABLISHMENT

* Treat seed by soaking in warm water for 24 hours.

* Plant seeds in polythene tubes at 2 cm depth with four seeds per tube.

PLANTING AND SPACING:

1. Cultivated fields should be used rather than abandoned fallow areas.

   * Seedling cultivation is better on cultivated land for additional protection against grazing, fires and grass competition.

2. Transplanting should be done within 7-10 days of the real onset of the rains. (Early to mid December in North).

   * Soil should be moist to a depth of 40cm.
   * Seedlings should be 10-12 weeks old.

3. Space seedlings at 10x10 metres (100 trees / ha), with **2 plants per planting station.**

   * Higher density of young trees will provide earlier impact of benefits to farmers while compensating for their smaller size.

   * Denser numbers asssure greater survival. (They can be thinned later whenm their canopies meet).

   * The thinned trees can provide wood for fuel and other farm uses.

Demonstration

SEEDLING PROTECTION:

Acacia Albida is highly palatable to all herbivores, and especially during the dry season, since it is one of the few species with green foliage at this time.

1. Protect each seedling with some type of fence.

   * Treat fencing material with crankcase oil, solignum or pesticide.

2. If termites are a problem, use pesticide at base of each tree.

3. The trees also need protection from uncontrolled Fires.

   * Make a fire break 2 metres in radius around each seedling.

   * Clear grasse away from seedlings to eliminate water and nutrient competition.