PN-ABE-755
65497

AN INTERPAKS CASE STUDY OF THE

AGRICULTURAL TECHNOLOGY SYSTEM IN MALAWI

SUBMITTED FOR REVIEW AND COMMENT TO:

THE MINISTRY OF AGRICULTURE
GOVERNMENT OF MALAWI

PREPARED BY

BURTON E. SWANSON
ANDREW J. SOFRANKO
KATHLEEN CLOUD
JOHN B. CLAAR
EARL D. KELLOGG
CLARENCE J. KAISER

SUBMITTED BY

INTERNATIONAL PROGRAM FOR AGRICULTURAL KNOWLEDGE SYSTEMS
(INTERPAKS)
University of Illinois at Urbana-Champaign (UIUC)
113 Mumford Hall
1301 West Gregory Drive
Urbana, Illinois 61801

Prepared under cooperative agreement No. DAN-4148-A-00-4004-00 between the
United States Agency for International Development (USAID)
and the University of Illinois at Urbana-Champaign.

March, 1986

INTERPAKS CASE STUDY OF AGRICULTURAL TECHNOLOGY SYSTEM IN MALAWI

Executive Summary

The following analysis of the agricultural technology development and transfer system in Malawi was carried out using an analytical model developed by the International Program for Agricultural Knowledge Systems (INTERPAKS) at the University of Illinois at Urbana-Champaign. The functional model is broken into 4 subsystems, including policy, technology development, technology transfer and technology utilization. The model includes objective indicators that can be used to measure system functioning and gives specific attention to inputs, functions, outputs and linkages within and between each subsystem.

The case study itself involves both descriptive data about the organization and operation of the agricultural technology system in Malawi, as well as specific indicator data. The overall objective of the study is to accurately describe and measure the performance and output of the agricultural technology system in Malawi, to determine how well the system is functioning and to identify possible constraints to the development, transfer and utilization of improved technology by smallholders.

The case study consists of 7 chapters and an extensive bibliography of reference material and documents that were used in preparing the case. The chapters include: (1) country context, (2) policy, (3) technology development, (4) technology transfer, (5) technology utilization, (6) technology flow, and (7) summary, analysis and conclusions. The remainder of this executive summary will focus on some of the indicators which reflect the major findings of the study.

Policy

Malawi has maintained a strong, positive policy toward agricultural development since independence in 1964. For example, in the past 5 years, the agriculture and related departments of government have received about 10% of recurrent government expenditures. The Departments of Agricultural Research and Agriculture, which includes extension, credit and so forth, have received about half of these resources. Agriculture's share of the government's development budget, which is primarily composed of donor financed capital and infrastructure investments, has averaged about 20% over the past 5 years, with another 16% of development expenditure going for road and bridge construction and improvement.

Agricultural research receives about 0.72% of agricultural gross domestic product (AGDP), which is somewhat below the recommended 1% minimum level of investment in agricultural research for a small country like Malawi. Agricultural extension and the knowledge transfer function receive about 2.2% of AGDP, which appears to be adequate in aggregate terms. However, it appears that about 40% of these recurrent costs are actually being paid for out of the development budget. When donor financing of the Rural Development Projects (RDPs) within each Agricultural Development Division (ADDs) is complete, these recurrent expenditures must eventually be absorbed into the government's revenue budget, which may create serious problems in the future.

Other policy related indicators influencing the flow and utilization of technology include the following. First, price incentives seem to be adequate for some crops, particularly maize and tobacco, but not for others, such as groundnuts and pulses. For example, the farm gate price of

maize in 1984 was about 58% of the 1983 world market price and farmers sold a record 296,144 tonnes of maize in 1984 to the Agricultural Development and Marketing Corporation (ADMARC). Farm gate prices for groundnuts (1984), however, were announced at only about 50% of 1983 world market prices and ADMARC purchases dropped to a record low of only 9,866 tonnes. While these price indicators are simplistic measures of overall price policy, there appear to be important substitution effects occurring that reflect the relative profitability (i.e. returns to land and labor) of different crops, such as maize over groundnuts. While the government is committed to increasing overall agricultural production through adequate price incentives, there is clearly a need for more analytic input into price formulation across commodities.

Second, the availability of fertilizer and other chemical inputs appears to be expanding at about 12%/year (past 5 years) and in 1985, there was an average about 50 kilograms of fertilizer used for each hectare of land cultivated by small farmers. The comparable figure for estate farmers was 140 kg/hectare. Clearly, the government remains committed to expend scarce foreign exchange to purchase fertilizer and other agricultural chemicals to increase agricultural production.

Third, the availability of agricultural credit is also expanding rapidly, but in 1984 it was estimated that only about 15% of farm households actually received agricultural credit to purchase production inputs. Given the very low household income levels K137 or US$103/farm household, the lack of sufficient agricultural credit appears to be a very important constraint limiting farmer access to improved technology.

The overall policy of the government toward the agricultural sector, the agricultural technology system and toward increasing agricultural output appears to be consistently positive. The constraints that do exist (e.g. lack of credit) appear to be a reflection of the fact that Malawi is a very poor country with limited resources. However, over the past two decades, Malawi has invested a substantial share of its scarce resources in the agricultural sector and appears to have done so with considerable skill. The result has been self-sufficiency in maize production, substantial and increasing agricultural exports, particularly from the estate sector, and overall growth in the agricultural sector averaging about 2.1%/year in real terms since 1980.

Technology Development

The agricultural research system in Malawi is highly focused on applied and adaptive research aimed at technology development, rather than emphasizing disciplinary research. The organizational structure of the Department of Agricultural Research (DAR) was substantially changed in 1984 to allow more national direction and control. The new system is organized around national commodity research teams which are grouped by type (e.g. cereals, grain legumes and oil seeds, and so forth) and guided by a national research coordinator. This new organizational structure will more closely link the DAR to national agricultural development objectives, improve resource allocation to priority research, place scientific leadership in the hands of the most highly trained and competent scientists and substantially improve the linkage between research and extension through the formation of Adaptive Research Teams (ARTs), which are assigned to each Agricultural Development Division (ADD).

As mentioned above, agricultural research receives about 0.72% of AGDP, which is growing at about 5%/year in real terms. Resources available for programs and operations in the DAR averaged about 43%, with 51% for salaries and personal emoluments and 6% for capital expenditures. The current percentage of the research budget spent on program and operations appear low. Generally, resources allocated for programs and operations should be at about the same level as for salaries to insure that researchers have sufficient resources to conduct their research programs. This balance is particularly true for applied and adaptive research programs that have considerable travel to off-station research sites.

The allocation of resources between commodity research programs is relatively good, however, the maize, roots and tubers, tobacco and groundnuts research programs are receiving a relatively low share of research resources in relationship to their value to the agricultural economy of Malawi. Agro-forestry research also needs more resources. The Adaptive Research Teams also need additional staff, particularly at the technical support level, as well as immediate staff development efforts.

The human resources available to agricultural research include about 200 professional level research scientists and research administrators or about 0.28 scientists/million US dollars of AGDP. Over 90% of these research personnel are Malawian and 45% have post-graduate qualifications (M.Sc. or Ph.D. degrees). There is a 2.5 technician to scientist ratio if both technical officers and assistants are included.

Access to external technology, especially from the International Agricultural Research Centers (IARCs), appears high as Malawi focuses on assessing and adapting externally developed technology to the needs of its

farmers. For a small, poor country, this emphasis on borrowing new technology from the international system appears to be an efficient allocation of resources.

The overall research system appears to be quite productive with 0.4 research papers/reports, 1 new technical release (variety or other recommendation) and 6.6 technology transfer activities (workshops, demonstrations, etc for extension and/or farmers) completed each year/scientist. Access to farmer feedback was rated as moderate.

Technology Transfer

Knowledge transfer to smallholders in Malawi is handled through the Department of Agriculture, which is hierarchically organized into 8 Agricultural Development Divisions (ADDs), 28 Rural Development Projects (RDPs), 180 Extension Planning Areas (EPAs) and approximately 1700 Sections, where front line extension agents (field assistants) are assigned. An integrated agricultural development approach is followed, with crops extension, livestock, credit, land husbandry and women's programmes being handled through a comprehensive program of knowledge transfer. The Agricultural Development and Marketing Corporation (ADMARC) is the sole supplier of agricultural inputs, as well as being the primary marketing agency, for small farmers. It is closely integrated with ADD programs and structure.

Knowledge Transfer, or agricultural extension, receives about 2.2% of AGDP (or 2.8% if only smallholder AGDP is included), which is growing at about 7.5% annually. However, as mentioned earlier, it appears that about 40% of the recurrent costs of the ADD's are funded from the largely donor financed Development account. The obvious danger of this approach is that

when the development cycle for an ADD has been completed, it will be very difficult for government to maintain this level of recurrent costs. Since it is difficult to cut staff, the proportion of resources available for program and operations generally declines, resulting in an inefficient transfer system. There is some evidence that pattern is beginning to emerge, since resources for program and operations in the government's recurrent (revenue) account has declined from about 47% at the beginning of the eighties, to only about 37% of the 1985/86 Department of Agriculture recurrent budget. This appears to be the result of major increases in DOA staffing since the late seventies, when the National Rural Development project began to be implemented.

The human resources available for knowledge transfer include about 1680 field assistants or about 1 assistant for every 820 farm households in 1985. The percentage of subject matter specialists (SMS) in Malawi appears unusually low, with only about 4% or the SMSs being available for livestock and crops (less than 2% if only university graduates are included). This is a very inadequate number to link with research, as well as to backstop and train field agents. This proportion of SMS, compares poorly with 18-20% SMS (with post graduate qualifications) in North America and Europe, 13% in Latin America and 6% in the rest of Asia and Africa (these percentages include only SMS with a university degree or higher qualification).

Extension's access to new technology was rated as fair to good at the national level, particularly through the publication of the annual Guide to Agricultural Production in Malawi. However, location-specific technology was not yet available to extension personnel in 1985, even at the ADD

level. Adaptive Research Teams (ARTs) are being organized to help bridge the gap between research and extension and to provide more location specific technical recommendations at the rural development project (RDP) and, eventually, at the extension planning area (EPA) levels. The ARTs should also improve extension's feedback to research, which was rated as moderate to poor.

In terms of job assignments, field assistants were estimated to spend about 80% of their time on knowledge transfer and 20% on credit related activities. As the number of farmers gaining access to credit increases from about 10-15% in 1985, the proportion of time allocated to knowledge transfer may decrease. For example, one ADD with more farmers receiving credit already estimates that field assistants spent 40% of their time on credit activities.

The administration and supervision of extension personnel was rated as very good with respect to personnel procedures and sanctions, however, incentives for added training and quality performance were lacking. Extension salaries were rated as very comparable to other similar types of employment. The typical field assistant is assigned to a section for about 4 years before being transferred; this level is just within the 4-6 year range considered to be the most desirable length of extension assignments in one location.

Given that Malawi uses a modified Training and Visit (T&V) system of extension, it was reported that field assistants receive a total of about 30 days of training per year. This level of training is very high, however, given the low proportion of SMSs and the availability of only national level technical recommendations. Training sessions were

frequently reported to be very general, repetitious and boring. Therefore, while the quantity of in-service was rated as high, the quality was rated as poor.

The teaching tools, teaching aids and mobility of field assistants was also rated as poor, given that an estimated 40-50% lacked a bicycle for mobility and few had any type of equipment or teaching aids to use when conducting field days, demonstrations and meetings. The ratio of agricultural information staff to field assistants was computed to be 1:78, however, much of the Extension Aids Branch effort goes into mass media and the mobile units, rather than in preparing teaching aids for use by field assistants.

The technical dissemination activities of field assistants was rated as very high, given than, on average, each field assistant conducts 2.7 individual activities (e.g. farm visits) and 0.5 group activities (e.g. meetings, demonstrations) per working day. In addition, the Extension Aids Branch carries out 28 minutes of technical radio broadcasts per day, plus another 14 minutes/day of general interest agricultural programming.

Flow of Technology

In tracking the flow of new technology through the system, there appears to be a well organized, centralized system that is very conservative and cautious about approving recommendations. There is some evidence that the system may be too conservative in the approval process and that it does not take full advantage of all available data, thus unnecessarily slowing the flow of new technology to farmers.

The Ministry appears to be excessively regulating the flow of certain types of technology, with the expressed purpose of protecting the small

farmers from unproven technology. The Ministry feels it is putting its own credibility on-the-line each time it approves and recommends a new technology. Therefore, rather than involving farmers more directly in the technology development and approval process, and sharing more of the decision-making with farmers, the DAR tends to test new technological components (e.g. varieties and pesticides) excessively before they are eventually released. This problem seems particularly true for private sector technology.

The addition of the Adaptive Research Teams (ARTs), which will be assigned to each ADD, should be particularly helpful in both generating and in improving the flow of location-specific technical recommendations to farmers. Previously, the centralized technology development and approval process resulted in general recommendations for the country as a whole, rather than being tailored to specific agro-ecological zones or to the specific socio-economic situation of different groups of farmers.

Technology Utilization

In 1980/81, the average farm household had 1.17 hectares of land, which was a 24 percent decrease from 1968/69. Approximately 65% of all farm households have less than 1.25 hectares, the estimated minimum requirement for meeting subsistence needs. About 30% of all farm households are headed by women and of those farms with less than one-half hectare, over 40% are operated by women. The average farm household size in 4.5 persons, with an average household income level of 137 kwachas (US$103). Eighty-one percent of this income comes from farm income.

The direct access of farmers to knowledge transfer activities was most recently assessed in the Annual Agricultural Survey of 1982-83. According

to these unpublished data, during the previous one year period, about 3.5% of farmers received a farm visit, 5.8% attended a demonstration or field day, and about 20% attended a group meeting. These data suggest that extension has contact with a relatively small proportion of farmers, but that these tend to be intensive or multiple contacts.

In 1985, only 18.6% of farm households were represented in farm clubs, the primary point of access to credit, as well as technical information. In terms of access to input supply points, the National Sample Survey of agriculture 1980/81 found that about 18% of farms are with 2 kilometers of an ADMARC depot and 76.6% are within 8km (about 5 miles). The density of input supply points was calculated to be 1 depot/788 farm households. Overall, most farm households have good access to input supply points and the situation is improving each year. Finally, only 18% of farm/households have radio receivers, which could given them direct and regular access to technical farm broadcasts.

Actual utilization of modern physical inputs by farmers is still relatively limited, but increasing rapidly. For example, the National Sample Survey reported that between the surveys of 1968/69 and 1980/81 the percentage of all farm households using any type of fertilizer on any crop had increased from 12.9% to 32.7% and that the volume of fertilizer sales had increased from 9,906 tons to 49,142 tons. Although fertilizer sales have increased substantially over the past two decades, it was estimated that since 1981/82, the demand for fertilizer has increased nearly twice as fast as the increase in supply. Given that average farm household incomes is low, access to credit appears to be the major constraint to the more rapid utilization of fertilizer and the other improved technical packages.

For example, the primary reason farmers gave for not adopting fertilizer on maize was insufficient money or credit.

The utilization of improved technology by farmers is very mixed, depending upon whether purchased inputs are required and whether the practice is perceived to be necessary by farmers. Utilization of purchased inputs and credit is directly correlated to size of holding as well. For example, farmer use of hybrid maize and fertilizer on maize increases in nearly direct relationship to increases in farm size.

At the same time, however, the adoption of certain recommended cultural practices was relatively high for all farmers. For example, 73% of all maize plots were planted in pure stands, 79% of farmers reported planting early, and 40% were weeding more than once. When non-adopters were asked why they didn't adopt certain cultural practices, the common response was that they "felt it to be unnecessary".

The overall effect of the larger smallholders having greater access to improved technology, especially the purchased inputs, was that their average yield levels were higher. In 1980/81, farmers with 0.5 hectares or less of land averaged only 970 kg of maize/hectare, while smallholders with 3 or more hectares of land averaged 1687 kg/ha. Again, this is further evidence of an important direct relationship between farm size and utilization of technology.

In summary, the utilization of improved technology by farmers in Malawi appears to reflect a continuum ranging from relatively high use of purchased inputs and other improved technology among the larger estate farmers on one end, to moderate use of improved technology among the larger (2-3 + ha) smallholders in the middle, to the very limited or non-use of

purchased inputs among the very small farmers (less than one-half hectare) on the other end. Overall access to purchased inputs, associated with improved technology, appears to be largely constrained by the lack of sufficient credit. As more credit becomes available, national pan prices for each commodity will need to be systematically adjusted to reflect national goals and the efficient use of national resources.

Conclusion

Overall, the agricultural technology system in Malawi is well supported and, for such a young system, it has made impressive progress. The system appears to be functioning reasonably well and to be productive. Where constraints exit, the leadership appears to be moving systematically to improve these weaknesses. The small farmers of Malawi are utilizing the technology coming through the system and they appear to be very price responsive. The primary constraint to the more rapid utilization of improved technology appears to be lack of credit.

INTRODUCTION

Malawi is a small landlocked country in southeastern Africa which is ranked among the world's lowest income countries, yet according to World Bank figures (1984) it has enjoyed one of the faster increases in GNP per capita of any country so classified: 2.6 percent annually since 1960. Much of this growth has been in agriculture and, because of this, Malawi is pointed to as one of the "success" stories of Africa. At a time when attention is focused on food shortages, Malawi has demonstrated a capacity not only to feed itself, but to export a sizeable surplus of maize to its hungry neighbors.

Although blessed with better climate and land than some of its neighbors Malawi faces many of the same problems. It has a very high population growth rate which places increasing pressure on a limited land base. Twenty years ago, at independence, there was very little infrastructure. Investments in human capital had been low and many of her citizens were migrant workers abroad. Yet with low levels of urbanization the economy has been able to reabsorb most of these workers. A set of capable and well functioning agricultural institutions are in place and agriculture is providing the engine for national development.

Agriculture currently contributes 37% of GDP. Between 1973 and 1979 agricultural production growth averaged 5.3% per annum in real terms. Between 1979 and 1982 the agricultural sector declined on an average of nearly 1%/year in real terms but has increased again to around 4% growth during the last three years. Much of this growth has been from export crops produced in the estate sector which now produces about 21 percent of agricultural GDP. The much larger smallholder sector, which produces both export crops and the nation's food has also grown although it experienced a

downward trend during the period in 1979-82 as reflected above.

Because Malawi has a record of successful commitment to the development of agricultural production it was chosen as the subject of the first in a series of case studies of national agricultural technology systems. The case will not attempt to establish the extent to which the technology system is responsible for increased agricultural production. Rather it will describe and assess in detail how the transfer system functions within the national food system.

The technology system is but one of the system components that make up the overall national food system. Many factors can influence agricultural productivity and total food output. National food production is a function of the climate and resources of the country; the farmers who work the land, including both their labor and management skills; the capital inputs farmers have available and can use; and, of course, their technology of production.

Factors exogenous to the technology system also influence the utilization of technology by farmers, the availability of reliable markets, the availability and cost of transport, access to purchased inputs; the availability and cost of production credit; governmental policy with respect to product prices, factors costs, infrastructure investment, and so forth. All of these factors that influence the utilization of improved technology by farmers will be examined briefly in the case. However, the major emphasis will be on description of the four functional areas of the INTERPAKS model of an agricultural technology system; policy, technology development, technology transfer and technology utilization.

The case is divided into seven chapters. The first chapter outlines Malawi's resources and constraints and provides a context for understanding the agricultural technology system. The next four chapters treat Policy, Technology Development, Technology Transfer and Technology Utilization. A straight forward description will be given of the resources, organization, functions and output in each of these areas. This will be followed by a description of the flow of technology through the system from one functional area to another. The final section will be a summary and analysis of the technology system outlining areas of strength and concern as they are presently understood.

THE COUNTRY CONTEXT

History

The earliest evidence of human habitation in Malawi are stone tools 100,000 years old, found near Karonga. The more specialized tools used by hunters and gatherers of the middle and late stone ages are found throughout the country. Around the third century A.D., Bantu speakers came from the north, bringing with them a knowledge of iron-working, farming, pottery and cattle-keeping. Settling in villages along the lake-shore and river valleys they were joined a thousand years later by a new wave of Bantu immigrants and for centuries people lived in small independent tribal groups.

By the sixteenth century these groups were gradually folded into the Maravi empire, a loose but powerful confederation of states which eventually included much of eastern Zambia, southern and central Malawi, and northern Mozambique. With increasing European contact and the expansion of trade in guns and slaves, the empire gradually declined and by the nineteenth century much of Malawi was in upheaval. Not only was southern Malawi crossed by a major route for ivory and slaves from their source in the Congo to the markets in Zanzibar but there were also a series of invasions by pastoralist groups from the south who had been displaced by the Zulu wars.

In 1859 the arrival of the Scottish missionary-explorer David Livingstone introduced the British presence into Malawi. Livingstone's accounts of the cruelty of the slave trade and the agricultural potential of the region led to a wave of British missionary activity that extended

for over a century and led to the eventual establishment of Malawi as a British protectorate in 1891. The first attempt at European technology transfer is worth noting. Bishop Mackenzie, the first missionary, remarked "I came to teach these people agriculture but now I see that they know far more about it than I do" (Clough, 1984).

From the 1890's onward large amounts of land, particularly in the Shire highlands, passed into the hands of foreign settlers who developed coffee, cotton and tobacco estates. Low estate wages and low prices for smallholder production led many Malawian men to migrate for work to the mines of Rhodesia and South Africa which further depressed smallholder agriculture. Conditions were bad enough to lead one historian to describe Nyasaland, as Malawi was then called, as "one of the empire's slums" (Vail, 1982).

In 1953, the imposition of the Federation of Rhodesia and Nyasaland provided the impetus for an active independence movement and after several years of struggle, Malawi became a fully independent state in 1964. It functions as a democratic republic within the British Commonwealth with a one-party system whose legislative powers are vested in an elected unicameral national assembly. Judicial powers rest in both magisterial and traditional courts. President for Life Dr. Hastings Kamuzu Banda, who has served as President since independence, holds executive powers as both Head of the ruling Malawi Congress Party and Head of Government.

Malawi's Portfolio of Resources and Investments at Independence

At independence, Malawi faced a number of constraints, some inherent in its geography, some the result of colonial policies. Although there were few known mineral resources, there was an environment capable of supporting diversified agriculture and a pre-colonial record of agricultural productivity. In 1964, Malawi's agriculture was bifurcated. There was a seriously exploited smallholder sector characterized by low producer prices, labor shortages and high levels of male out migration. The primary subsistence crops were maize, millet, cassava, and beans; groundnuts were used both for export and for subsistence. The estate sector was largely operated by Europeans who depended on cheap African labor. The traditionally exported crops included tobacco, cotton, tea and coffee. The world market for these crops was uneven. Strong for some, for others it was uncertain and volatile.

There was little infrastructure in the country. Aside from lake transport, transportation routes from north to south were very sketchy. There were only 200 miles of paved road in all of Malawi. A major constraint to Malawi's export of agricultural products was difficulty of access to ports. Because Malawi is land-locked, it must depend on rail transportation through neighboring countries and from earliest colonial days this has presented a problem. There are two railroads going from Malawi through Mozambique to the ocean. The longer route to Byra was built during colonial times. Transportation of agricultural products on these railroads has always been expensive and has burdened Malawi's agricultural production with high transport costs. To compound this problem, in 1984

internal unrest in Mozambique closed both of these railroads, therefore, all imports and exports must move by road, either through Tanzanian or South African ports. Because of this Malawi must export crops which are high in value for their weight so that the added cost of transportation does not price crops out of the world market.

The colonial government had given low priority to investments in education; primary education was almost entirely in the hands of mission schools and at independence there were only 33 university graduates. Although Malawians had been successful traditional agriculturalists for centuries, there were few individuals with the technical training necessary for modern scientific agriculture. Yet the economy continues to be dependent upon the export of agricultural products into an increasingly competitive world market.

Natural Resources

Malawi has been relatively fortunate among African countries in its agricultural resource base, the land and the climate permit the growing of a large variety of crops. A lake running nearly the full length of Malawi from north to south, provides both a source of food and a means of transportation by water.

Average rainfall varies from 650 mm to over 2,000 mm within the country; but in the main agricultural areas the range is 750 to 1200 mm. Rains normally come in the south in early November and move progressively northward until early in December. They generally last until April, though there is considerable variation both between years and in the distribution of rainfall throughout the year. It is not unusual to have droughts within

the rainy season.

Temperatures vary with altitude. The coolest temperatures are in the northern and central region plateau where the monthly temperatures range between 11 and 29 degrees centigrade. Frost is rare except in the very high plateau country in the north. This lack of frost is an important consideration in winter cropping and in crop diversification strategies. The warmest areas are along the lake-shore and in the Shire River valley where temperatures may go as high as 36 degrees centigrade.

The geography is diversified, ranging from the plains of the Shire River Valley in the south, to the mountain highlands in the north. The total land area is 92,300 Km^2 of which approximately 36,200 Km^2 is arable. For comparison, Malawi is approximately the size of Pennsylvania. Moving from south to north, there are four major agro-ecological zones:

- the lower Shire Valley which is a low semi-arid savannah characterized by relatively high temperatures and low rainfall. Traditional crops include millet and sorghum, cotton and pulses as well as domestic livestock. Since independence, sugar estates and irrigated rice production have been promoted and smallholder maize and cotton production have increased.
- The Lake-shore and the Upper Shire Valley are also savannah lying between 300m and 600m elevation and have both high and low rainfall areas. In these somewhat more temperate areas, maize and groundnuts are important crops, along with cotton. Some tobacco is grown and considerable fishing is done along the lake.
- The plateau areas of the center and north cover three-fourths of the total land area and lie between 800m and 1600m. Climates are more temperate and

rainfall more regular. Maize and groundnuts are important smallholder crops. Livestock, vegetable and pulse production are also common. Substantial amounts of tobacco are raised by both smallholders and estates. -The highland areas lying between 1800 and 3000 m above sea level are high rainfall areas where natural vegetation are grasslands and evergreen forests. Most of the highlands are in the north, but there are also some southern highlands. Aside from forestry, and cattle grazing lands, they also contain coffee and tea estates and an increasing number of smallholder tea and coffee producers.

According to government studies, the soils of Malawi can be divided into four main groups. The red and brown clay soils can be highly productive if they are managed moderately well. Fertilizer response for these soils is generally limited to nitrogen and phosphorous. Black cotton soils are very fertile and can be very productive but excellent management is required. Their fertilizer requirements are very low. Sandy soils are more prone to structural damage under poor management. They don't retain moisture well and water logging can occur when the soil structure has been damaged. Under good management, high yields can be obtained on these soils for most crops; however, yields will be less consistent because of fluctuating soil moisture levels. The sandy soils are quite acidic and have the tendency to become more acid unless limestone is periodically applied.

Human Resources

The people of Malawi are one of her major resources. Hard working and intelligent, they are deeply committed to the land. In the North, the

predominant cultural groups are the Ngonde, the Tumbuca, Tonga and Ngoni: all are patrilineal pastoralist groups who emigrated over the centuries either from further north, or from southern Africa during the Zulu wars of the early nineteenth century. The Chewa, Yao and Senga of the central region and the Lomwe and Nyanja of the south are agriculturalists, many of whose ancestors emigrated from the Congo basin in central Africa centuries ago. Despite the differences in origin, language and culture, there appears to be little ethnic friction among the groups and a fairly high degree of common linguistic understanding.

Although there are many commonalities, each group has its own language and customs which may influence their response to new technologies. For example, several of the agricultural groups, including the populous Chewa, are matrilineal and matrilocal and land rights traditionally pass through the mother's family rather than the father's. In such groups, women are more likely to be seen as important agricultural decision makers. Malawi's increasing emphasis on reaching women farmers may be an effect of this cultural tradition.

The country's population density is high by African standards. The average in 1966 was 43 persons per square kilometer. in 1982 it was 65 persons per square kilometer or 170 persons per square kilometer of arable land. Average farm size was 1.17 hectares of cultivated area according to the 1980/81 Sample Survey of Agriculture but farm size varies substantially with household size and region of the country. Twenty-eight percent of rural households are headed by women and they tend to have smaller farms.

Rural population is quite unevenly distributed. (See Map Exhibit 1-1). Approximately 12 percent of the population lives in the northern regions, 30 in the central region and the remaining majority in the southern region. Since independence, the government has undertaken a series of investment strategies to support the development of the less populated regions, first in the center and now in the north. These strategies have included the movement of the nation's capitol from Zomba in the south to Lilongwe in the center, as well as extensive investments in integrated agricultural development projects. Considerable internal migration has resulted, most of it between rural areas. The urban population is still only 10 percent and it is increasing at a rate of about 7 percent a year.

Ninety percent of Malawi's population of 6.4 million people live in rural areas and even in urban areas, the population produces much of its own food supply. The statement was repeatedly made that Lilongwe, the capitol city, was self-sufficient in food either because family members (primarily wives) produced on nearby farms or they returned to their home farms during the growing season to produce the family's food.

The average household size in the rural areas is about 4.5 persons and with an average annual population growth rate of approximately 2.9%; 45 percent of the population is under 15 years of age. Infant mortality is high and life expectancy at birth is only 44 years. Malawi's Physical Quality of Life Index (PQLI), which is based on life expectancy at age one, infant mortality and literacy is lower than many comparable African countries. The regional average for the SADCC countries is 44, while Malawi's score is 31. According to the 1980/1981 Agricultural Census, the

average rural diet provides only about 94% of the average daily caloric requirement. However, there is considerable seasonal variation in the availability of an adequate food. Data from the National Sample Survey of Agriculture shows that malnutrition is a major problem particularly in the months before harvest when the work load is heaviest.

Although Malawi has invested less in education than many of her neighbors, there have been substantial improvements in education since independence. In 1966, adult literacy was estimated to be 26.2 percent for men and 2.4 percent for women, in 1977 the figures were 40.8 and 17.4 percent, respectively. By 1980-81, 58 percent of primary school age children were in school and 4 percent of the secondary age children were in secondary school. Agricultural education is included in the primary curriculum. Many of the secondary schools have technical training programs and there are a variety of vocational training programs at both the post primary and post secondary levels, in addition to teacher training schools and technical schools.

Among the post-secondary institutions is the new Natural Resources College (NRC) which replaces two smaller agricultural schools. It provides a two year certificate training in agriculture, home economics, veterinary science, fisheries, wildlife and game, and soil survey. The government pays all student fees and an allowance. The certificate qualifies graduates to work as Technical Assistants in extension, or in other sections of the Ministry of Agriculture. Ninety five percent of the students come from rural areas and competition for admission is very strong. In addition to certificate students, the NRC is to give in-service

training courses for teaching staff and technical assistants who were trained in earlier years.

The University of Malawi, which includes Bunda Agricultural College, Chancellor College (Arts, Sciences, Law,Public Administration and Education), the Polytechnic Institute and the College of Nursing was founded in 1966 to provide opportunity for higher education within the country. Until 1985, the government paid all student fees, but this policy is now changing.

Bunda College has four departments: Agricultural Engineering, Crop Production, Livestock Production and Rural Development. As of 1984, there were 28 PhD and 23 MSc degree holders on the faculty. It offers both diplomas (three year) and BSc degrees (five year) in general agriculture. The college currently offers no postgraduate courses but the curriculum is being revised to offer some degree of specialization. Some ninety percent of the students are from rural backgrounds and admission to Bunda is considered prestigious. Between a third and a fourth of the students who complete the diploma are selected to stay on for a B.Sc. degree. Diploma graduates who go to the field may also return later, if they are qualified, to finish the B.Sc. degree. A number of the senior members of the extension service have done so.

All students who successfully complete their courses are offered employment in the ministry or join the private sector. The ministry, with the exception of members of the Economic Common Service, is staffed almost exclusively with Bunda graduates. Men and women students are equally qualified to accept these positions, since, with the exception of one

course, their training is the same. Historically, there have been very few women completing the B.Sc. in Agriculture. However, as opportunities for advancement within the ministry have improved, the number of women in the agriculture degree program has increased. The expansion of Women's programs, with their increased emphasis on agricultural training for farm women, have contributed to the increased demand for women with agricultural training at every level of the system.

Malawi's Agricultural Development Strategy

Faced with their geographical position, resource base and constraints, the Malawi Government has evolved a strategy that preserves the division of their agriculture into two sectors - a smallholder sector and an estate sector. Current estimates are that about 1.2 million smallholder families cultivate 1.332 million hectares and produce about 80 percent of Malawi's total agricultural production. The estate sector tills less than .5 million hectares, accounts for about 20 percent of production and provides 45 percent of the wage employment in the country (Manda, et al, 1985 and USAID, 1985). Estate sector use of land expanded at a rate of 10-15 percent annually in the 1970's and continues to expand in the 1980's, although more slowly. In both sectors the farmers are now overwhelmingly Malawian with the principal difference between the two sectors being not so much the size of the holdings, but the crops farmers are permitted to grow and their land tenure systems.

The estate sector is characterized by the use of lease-hold or free-hold land. Outright ownership or long-term leases permit estates to make the long-term investments necessary for export crops such as coffee, tea,

sugar, nuts, flue-cured and burley tobaccos. The government is now encouraging the estates to diversify into wheat, macadamia nuts, cotton and groundnuts, as well as permitting them to grow maize. The estate sector is not presently served by the Government's extension or marketing services. Estate crops are sold directly onto the world market by producers who also purchase their own inputs from the private sector. Sales of tobacco and tea are directly taxed at the point of sale to fund a producer governed research effort for these commodities. Other estate crops benefit from government supported research.

The vast majority of farmers are in the smallholder sector, which is characterized by rainfed semi-subsistence production, with customary use rights to land. The main crops grown by smallholders are traditional (flint) and improved maize, with traditional varieties constituting 90% of the area and 80 percent of the production.

Cassava, yams, millet, sorghum and rice are also staple crops in certain areas, while pulses and groundnuts are either intercropped or grown in pure stands to provide much of the protein in the diet of rural Malawians. Many farms also raise poultry and livestock, as well as tree crops and vegetables both for consumption and for sale.

The principal cash crops for smallholders, aside from maize, are groundnuts, cotton, and oriental, fire cured and sun/air cured tobacco. Table 1-1 gives an excellent overview of the production, yields and labor requirements of most of the major crops grown in Malawi.

Table 1-1

MALAWI: SMALLHOLDER PRODUCTION, AREA, AND INPUTS 1981

	Production (MT/yr)	Area (ha)	Yield (MT/yr)	Cropping Labor Use (Mandays/ha)	Cropping Fertilizer Use (Kg/ha)
Maize					
Unfertilzed local	735,000	686,000	1,070	85	--
Fertilized local	275,000	198,000	1,390	110	150
Fertilized improved	226,000	87,000	2,590	120	350
All maize	1,236,000	971,000	1,270	95	60
Groundnuts	62,400	165,900	380	170	25
Rice	48,100	25,000	1,900	270	100
Cotton	21,700	38,700	560	250	25
Tobacco	12,800	39,200	330	400	250

Sources: Production and area-1980/81 National Sample Survey of Agriculture preliminary data tables, Malawi Smallholder Fertilizer Project Staff Appraisal Report, pp. 69, 73. Labor--GOM, "Mzimba Rukuru-Kasitu RDP Proposals", Annex 12, p. 1, 1977; GOM, "Ntchisi RDP Proposals" Annex 8, p. 1, 1977; GOM, "Proposals for the Agricultural Price and Intervention Policy 1983/84", pp. 79-98, 1983. Fertilizer--Malawi Smallholder Fertilizer Project Staff Appraisal Report, p. 71, 1983; authors' estimates.
Table from: Agricultural Pricing in Malawi: a Reduced Form Model - World Bank CDP Discussion Papers.

Agricultural Institutions

The institution responsible for overall management and coordination of the smallholder sector is the Ministry of Agriculture. Since independence it has expanded both its responsibilities and its capabilities to combine the strengths of both centralized and decentralized decision making.

In the early years, the government's strategy was to invest development resources in a limited number of the most productive areas. With loans from the World Bank and support from donors, intensive investments were made in developing the central plains of Malawi around

Lilongwe and the fertile plains in the south near the Shire river. These were followed by investments in the lake-shore plains. Since 1977, the government has made a commitment to expand the investment more widely across the country through means of the 20 year National Rural Development Program (NRDP).

The country has been divided into eight Agricultural Development Districts (ADDs) which are subdivided into 3-5 Rural Development Projects (RDPs). A combination of government resources and donor grants and loans are scheduled for introduction to a number of new RDP 's each year until 1990 to equalize the development resources available throughout the country. The aims of the program are to increase production of both food and cash crops, while preserving the natural resource base. At the farm level, efforts are concentrated on extension and credit services, as well as livestock improvement.

The Ministry of Agriculture also has oversight responsibility for the Agricultural Development and Marketing Corporation (ADMARC), the government marketing parastatal which provides smallholders with a source of reasonably priced inputs and a market for commercial agriculture production. ADMARC purchases smallholder crops at pan-national prices which are adjusted yearly. Malawian farmers are given price information in a timely and reliable manner both through extension and through National Congress Party officials.

Smallholders are not required to sell any crop, except tobacco, to ADMARC and there are flourishing local markets where seasonal prices for certain commodities are considerably higher than ADMARC's. Because of

their large profit margin on smallholder tobacco, ADMARC is usually able to pay farmers a price for most crops slightly below the border price plus transport and still turn an overall profit. Estimates are that about 18 percent of maize production, 25 percent of groundnuts, and 30 percent of rice production are sold to ADMARC, the rest are consumed on the farm.

ADMARC also provides the smallholder's sector with its agricultural inputs through the same expanding network of seasonal and permanent marketing points. Local ADMARC marketing depots have provided access to output and input marketing services on a reasonably reliable basis, given the transport difficulties.

Exhibit 1-1:
Malawi - Basic Data

Location: Bordered on the north by Tanzania, the west by Zambia and the east and south by Mozambique. Between latitutes 9° and 17° south, longitudes 33° and 36° east.

Size: About 300 km north to south, less than 200 km from east to west. Total area of 188,484 km^2, of which 20% is covered by water.

Population: 6,452,000[a] - 1980; 3,419,000 - 1960
Rate of Population Growth: 3% per year
Percent of Population under 15 years of Age[b]: 1982 - 44.7%
Percent of Population in Rural Areas[a]: 1983 - 90%
Physical Quality of Life Index[c]: 31
Life Expectancy at Birth[d]: 960 - 36.5 - 1981 - 44 years
Adult Literacy Rates[e]: 1966 - 26.2% of men 1977 - 40.8% of men
1.7% of women 24.4% of women

Currency Equivalents - as of February 1985 US $1.00 = 1.50 Malawian Kwacha (MK) MK 1.00 = US$0.67
The value of the kwacha is tied to a bundle of currencies, which include the South African Rand

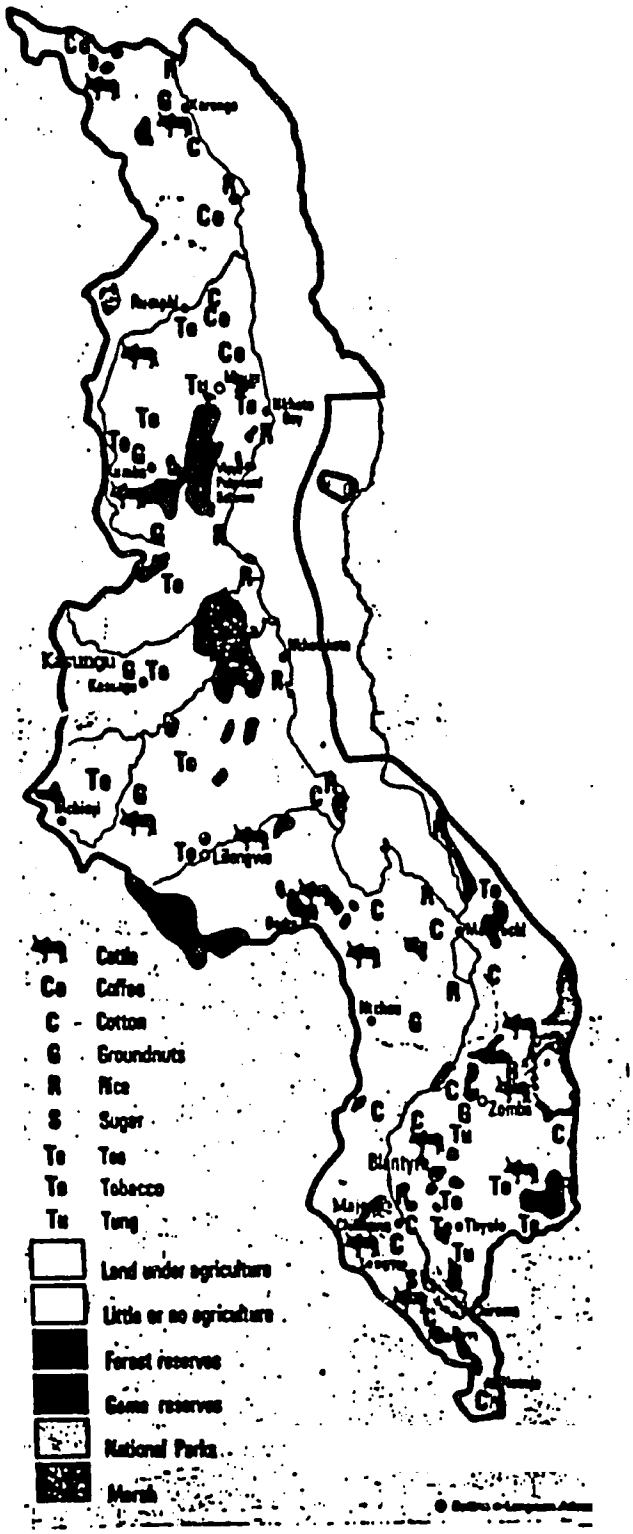
Per Capita GDP[d]: 1980 - US$200
Average Rural Household Annual Income[f]: 1981 - 137 Kwacha
Average Annual Rate of Inflation[d]: 1960/70 - 2.4%; 1970/81 - 10.3%
Number of College Graduates[a]: 1964 - 33; 1980 - 2656

Percentage of Households by Size of Cultivated Area (all Malawi)[f]

1968/69			1980/81		
Under	0.8	28.7%	Under	0.5	23.6%
	0.8 - 1.59	34.1		0.5 - 0.99	31.3
	1.6 - 2.39	18.4		1.0 - 1.49	19.0
				1.5 - 2.99	21.0
	2.4 and over	18.8		3.0 and over	5.0

Sources
[a] National Statistical Office and Economic Planning Division, Government of Malawi
[b] Malawi Statistical Yearbook, 1983
[c] Lewis, J. P. and V. Kalab, 1983, US Foreign Policy and the Third World Agenda
[d] The World Bank, World Development Report, 1983
[e] Malawi Population Census, 1977, Vol. 1
[f] National Sample Survey of Agriculture, 1981/82

LAND USE



Source: Atlas for Malawi: Colins Longman

POPULATION DENSITY

Source: Atlas for Malawi Colins Longman

EXHIBIT I-2
MALAWI CHARACTERISTICS OF THE SMALLHOLDER ECONOMY

	MALAWI	KARONGA ADD	MZUZU ADD	KASUNGU ADD	SALIMA ADD	LILONGWE ADD	LIWONDE ADD	BLANTYRE ADD	NGABU ADD
PERCENTAGE FEMALE HEADS	28.8	15.8	21.9	14.1	28.4	27.4	36.5	34.3	24.0
MEAN HOUSEHOLD SIZE	4.5	4.8	4.8	4.9	4.3	4.4	4.0	4.6	4.4
TOTAL CULTIVATED AREA (HA)	1.16	0.96	1.39	2.06	1.02	1.38	0.87	0.80	1.36
AREA CROPPED TO MAIZE (%)									
HYBRID	3.3	2.3	4.7	3.5	0.4	8.3	0.7	0.4	0.5
COMPOSITE	2.5	4.9	6.8	4.9	5.5	1.3	0.6	1.0	0.0
LOCAL	52.2	29.8	46.5	53.6	54.2	49.4	65.5	55.6	27.8
MAIZE YIELDS (KG/HA)									
HYBRID	3020	3084	2776	2856	--	3442	1255	1196	1394
COMPOSITE	1960	2442	1988	2217	1723	1850	1196	1960	--
MAIZE	1119	1369	1079	1322	1307	1206	870	1087	1237
AREA CROPPED TO RICE (%)	1.7	23.0	0.5	0.0	5.3	0.0	3.4	1.1	1.3
RICE YIELDS (KG/HA)	1955	2771	1031	--	1626	--	1695	1177	1395
AREA CROPPED TO MILLET (%)	1.4	6.3	9.1	0.7	0.2	0.1	0.0	0.1	5.8
MILLET YIELDS (KG/HA)	560	1096	350	419	--	235	--	714	604
AREA CROPPED TO SORGHUM (%)	1.5	0.3	0.0	0.0	0.1	0.0	0.5	1.6	17.0
SORGHUM YIELDS (KG/HA)	574	--	--	--	--	--	483	523	619
AREA CROPPED TO CASSAVA (%)	2.6	7.8	9.3	0.2	7.6	0.1	2.6	4.7	0.0
AREA CROPPED TO GROUNDNUTS (%)	9.8	1.0	8.6	21.7	5.1	15.8	2.1	0.9	0.9
GROUNDNUT YIELDS (KG/HA)	363	447	373	469	540	247	392	387	155
AREA CROPPED TO PULSES (%)	0.9	1.5	0.4	0.8	0.4	0.7	0.1	0.3	6.3
AREA CROPPED TO COTTON (%)	2.9	0.6	0.0	0.0	14.4	0.2	2.2	0.9	22.5
AREA CROPPED TO TOBACCO (%)	2.8	0.0	0.5	6.9	0.2	5.3	0.4	0.4	0.0
AREA CROPPED TO OTHER CROPS (%)	1.6	4.0	0.7	1.8	1.4	1.5	1.0	2.6	0.2
AREA CROPPED TO MIXTURES (%)									
MAIZE/GNUTS	4.5	3.2	2.1	1.4	3.0	4.7	9.4	5.7	1.7
MAIZE/PULSES	8.0	9.6	8.7	4.1	0.3	11.3	4.9	15.7	0.4
OTHER	4.4	5.5	1.8	0.4	1.8	1.3	6.6	9.0	15.4
MIXED MAIZE YIELDS									
MAIZE/GNUTS	923	1376	676	581	1262	762	942	1033	--
MAIZE/PULSES	1202	1488	1301	1528	691	1347	904	1131	--
MAIZE/OTHER	898	879	815	1233	762	1294	872	867	891

SOURCE: MALAWI, "NATIONAL SAMPLE SURVEY OF AGRICULTURE FOR CUSTOMARY LAND, 1980/81, PRELIMINARY REPORT" (ZOMBA, AUGUST 1982).

POLICY

INTRODUCTION

The success of an agricultural technology development, transfer and utilization system depends, in part, on the general agricultural policy context within which the system must operate. In this chapter, these policy elements will be analyzed in terms of how they directly and indirectly affect the agricultural technology system. These policies include the objectives and strategy established for the agricultural sector in national development, the institutional dimensions of the policy-making process and the specific policies and allocation of resources that directly affect the agricultural technology system. The specific policies identified and described below can be viewed as affecting the supply and/or demand of agricultural technology because certain agricultural policy measures directly influence the capacity and capability of the system to provide relevant technology. Other policies tend to affect the demand for technology by influencing farmers' ability and inclination to adopt it.

This chapter discusses these policy elements, indicating why they are important, and what was found to be the situation for each in Malawi.

MALAWI'S OBJECTIVES FOR AGRICULTURAL DEVELOPMENT

There are many possible objectives for agriculture's contribution to national development. Because these objectives set the overall direction for agricultural policy, it is important that objectives be realistic, internally consistent, and well understood by those implementing them. Malawi's objectives in this area are longstanding, and appear to be well understood by everyone in the country, from the President down to local farmers.

In Developing Malawi, the Government's statement of development policies, 1971-1980, the first paragraph states: "The vast majority of Malawi's population depends for its livelihood on peasant agriculture. It is in this sector that the national development effort is being, and must continue to be, concentrated." For 20 years the policy of the Malawian government has provided systematic support to agriculture in order to achieve well-defined national objectives. The same clearly stated agricultural objectives appear consistently in budget and planning documents, high level official speeches, and donor project proposals. In brief, these objectives are to:

1. Attain and sustain food self-sufficiency in staple food crops, especially maize.
2. Expand agricultural exports to generate increased foreign exchange.
3. Improve rural incomes to increase the quality of life in the rural areas.

These objectives seem pragmatic and appropriate. There may be some internal inconsistency between achieving self-sufficiency in food crops and expanding agricultural exports, and choices between the levels of attainment described in these objectives may become increasingly complex as Malawi diversifies its agriculture and seeks to expand production of exportable commodities. To date, the strategies adopted by Malawi have given it a fair degree of success in accomplishing these objectives, given the available resources and existing constraints.

In terms of the first objective, Malawi has made substantial progress. Following the advances in maize prices in the early 80's, Malawi has become self-sufficient in maize, the major staple crop, and since 1983 maize has been exported to neighboring countries. Furthermore, in 1985 there was a government reserve exceeding 300,000 metric tons of stored maize.

While progress in maize production has been impressive, production of other crops suggests uneven progress. In particular, the production and export of groundnuts has declined steadily, particularly since 1980. Overall, however, growth in the agricultural sector has been substantial, averaging over 4%/year in real terms, with the exception of the period 1979-82 and again in 1985. These data on the magnitude and growth in the agricultural sector, including both the smallholder and estate sector can be found in Tables II-1a and II-1b.

In terms of the second objective, which is the expansion of agricultural exports to generate foreign exchange, progess also has been impressive. During the period between 1964 and 1984 agricultural exports grew from a value of 22 mil. Malawi Kwacha (MK) to more than 421.9 mil. MK. In 1984, tobacco contributed 45.9% of the total agricultural exports, tea 26.7%, maize 11.7%, sugar 6.9%, groundnuts 0.5%, rice 0.2%, and other 8.0% (See Table II-21: Domestic Exports by Main Commodities).

The third objective is to the increase rural incomes in order to increase the quality of life in the rural areas. In the 1980/81 agricultural census, the average annual cash income per rural household was estimated to be 137 MK, with regional development district averages varying between K210 in Kasungu to K121 in Salima. Based on these figures the

World Bank estimated that 85 percent of the rural population is still below the real poverty line ($99 US income per year). A detailed breakdown of Household income by source and ADD, as well as expenditures by item is found in Table II-2.

Table II-1a
Agricultural Gross Domestic Product at 1978
Factor Cost for 1980-85
(K million)

	1979	1980	1981	1982	1983	1984	1985
Total Agric. Sector	304.1	284.1	260.7	278.7	290.6	308.8	313.9
Smallholder	252.8	231.2	210.7	216.9	224.7	243.3	247.2
Estate	51.3	52.9	50.0	61.8	65.9	65.5	66.7
GDP at Factor Cost	768.8	761.0	722.7	741.7	775.1	827.6	862.4
AGDP/GDP	39.6%	37.3	36.1	37.6	37.5	37.3	36.4

Source: Malawi Government (1985). Economic Report 1985. Budget Document No. 4. Zomba: Government Printer, p. 7, 12.

Table II-1b
Growth in Agricultural Sector Output 1973-85
Using 1979 AGDP As Base Year

Period	Smallholder Agriculture	Estate Agriculture	Total Agriculture Sector
1979 Base Year (million kwacha)	252.8[a]	51.3[a]	304.1[a]
1973-79	4.5	9.6	5.3
1979-82	-2.7	7.0	-0.9
1983	5.6	6.6	4.3
1984	8.3	-0.6	6.3
1985	1.6	1.8	1.7

[a] AGDP at 1978 constant prices
Source: Malawi Government (1985). Economic Report, 1985. Budget Document No. 4. Zomba: Government Printer, p. 12.

Table II-2

HOUSEHOLD INCOME AND CONSUMPTION RATE

Table A: Total Annual Household Cash Income and Income per Household, by Source

Source	Total Income Million Kwacha	%	Income per H/hold Million Kwacha	%
MALAWI	157.4	100.0	137	100.0
Food Crops	36.4	23.1	32	23.4
Cash Crops	16.9	10.7	15	11.0
Livestock	13.1	8.4	11	8.0
Business[a]	43.8	27.8	38	27.7
Labour	24.5	15.6	21	15.3
Transfers	22.7	14.4	20	14.6

[a]The most common business activities appeared to be grocery shops, beer brewing, tailoring, carpentry and other handicrafts.

Table B: Annual Household Cash Income and Annual Income per Household by ADD

A.D.D.	Total Income Million Kwacha	%	Kwacha per H/hold
MALAWI	157.4	100.0	137
Karonga	4.8	3.1	140
Mzuzu	11.7	7.4	136
Kasungu	29.2	18.6	210
Salima	9.4	6.0	121
Liwonde	32.4	20.6	134
Blantyre	34.4	21.9	142
Ngabu	9.1	5.8	124

Table C: Annual Household Expenditure by Item

Items	Million Kwacha	%
MALAWI	134.4	100.0
Farm	19.3	14.3
Business	11.5	8.6
Food	30.5	22.7
Livestock and by-products	3.1	2.3
Non-durables and misc.	34.0	25.3
Durables and semi-durables	25.5	19.0
Transfers	10.6	7.8

Source: National Sample Survey of Agriculture, 1980/81, V. III, National Statistical office.

THE MACRO ECONOMIC POLICY CONTEXT

Primary responsibility for national development planning rests with the Economic Planning Division of the Office of the President and the Cabinet (OPC). In recent years the Finance Ministry has assumed responsibility for national budgeting and, in collaboration with OPC, is responsible for the development and execution of economic development policy. The national budget is approved by the legislature, and though this process is basically one of formal approval, the political party exerts substantial influence in areas of widespread interest, such as pricing policy. Since the late 1970's, the donor community has become an increasingly important influence on development policy, and participates in dialogue with the government through a donor consortium.

Since independence, government policy has favored a relatively open economy with a major role for both domestic and foreign capital, and a stress on agricultural production for export (Kydd, 1985). The estate sector contributes significantly to Malawi's export earnings, producing about 80% of agricultural exports, with the remainder coming from the smallholder sector. The smallholder sector is responsible for producing most of the nation's food. Both sectors have

contributed substantially to Malawi's growth, but since 1980, the estate sector has grown more rapidly in real terms (about 5.2%) than the smallholder sector (about 1.4%; see Economic Report 1985, p.7).

A number of macro policies have proved to be helpful developing a strong agricultural sector: the openness of the economy, the relatively low inflation rates and realistic valuing of Malawian currency. These policies have allowed the country to increase export volume more rapidly than import volume. As shown in Table II-3, through the mid-1970's Malawi's international terms of trade were favorable, although this is apparently less true in the last five years.

Table II-3
TERMS OF TRADE, 1973-84
(Yearly average: 1980 = 100)

	Export Indices		Import Indices		Terms of
	Unit Value	Volume	Unit Value	Volume	Trade
1973	54.0	64.1	34.3	93.6	157.4
1974	68.5	64.0	46.4	95.2	147.6
1975	80.3	65.8	56.4	108.5	142.4
1976	89.8	73.1	64.5	81.8	139.2
1977	118.4	65.9	71.7	81.9	165.1
1978	106.5	63.2	72.0	108.3	147.9
1979	98.9	79.5	82.1	110.8	120.5
1980	100.0	100.0	100.0	100.0	100.0
1981	139.0	80.2	116.9	75.1	119.0
1982	151.6	73.2	125.8	71.7	120.5
1983 (est.)	149.3	78.4	155.7	65.4	95.8
1984 (est.)	200.6	94.3	201.2	55.6	99.7

Source: Montly Statistical Bulletin; data provided by the Malawian authorities; and IMF staff estimates as reported in Economic Recovery: Resource and Policy Needs.

It has also been policy to promote equitable rural/ urban terms of trade. This has been done principally through providing incentive prices to farmers, while using wage and price controls to preserve a low urban wage structure. The Malawian civil service, which is one of the most professionally competent and honest in Africa, is neither as large nor as highly paid as many on the continent. Because of

this, the economy has escaped the burden of supporting an expensive, rapidly proliferating urban bureaucracy.

Malawi's external debt is relatively high, representing about 49 percent of GNP in 1982. Debt service payments accounted for about 22 percent of the export value in 1982 (see Table II-4). Both of these percentages are relatively high compared to other low-income countries, but Malawi's exports have been growing more rapidly than imports since 1970. This indicates that the debt service should become less burdensome if heavy foreign borrowing can be constrained in the future.

Table II-4
MAJOR MACROECONOMIC INDICATORS

	1973-78	1979-84	1985-90
GDP Growth (% p.a.)	6.2	1.5	3.7
Export Growth (% p.a.)	6.1 a/	0.4	4.3
Import Growth (% p.a.)	3.7 a/	-12.7	3.6
Current Account of BOP/GDP (%)	-10.9	-14.1	-7.9
Average Debt Service Ratio (%)	12.6	24.8	30.5
Growth in Consumption per Capita	0.8	-2.5	1.2
Budget Deficit/GDP (%)	10.2	20.9	6.2
Domestic Savings/GDP (%)	17.4	14.1 b/	12.2
Gross Fixed Capital Formation/GDP	23.2	18.4 c/	14.3

a/ Figures for 1970-79 are given as more representative of the period.
b/ These figures are inflated by involuntary stock building arising from transport difficulties.
c/ By 1984, the ratio was down to 13.1 percent.

Source: World Bank. Economic Recovery: Resource and Policy Needs. July 1985

POLICY INSTITUTIONS RESPONSIBLE FOR SMALLHOLDER AGRICULTURE

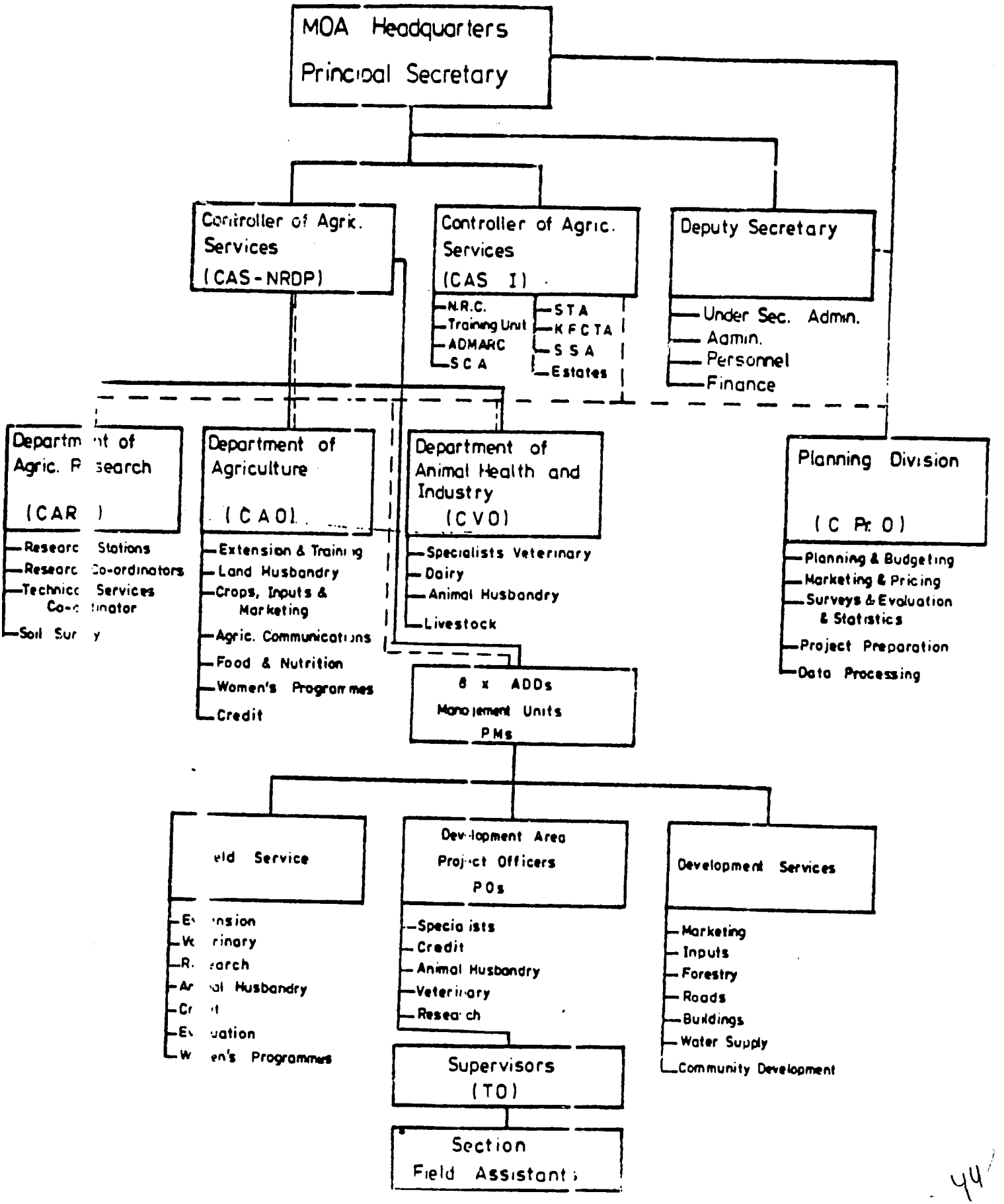
Policies specific to smallholder agriculture are set by the Ministry of Agriculture, in consultation with other appropriate offices and ministries. The ministry is charged with providing general direction to the parastatals (particularly ADMARC) and crop authorities (such as tobacco and tea), as well as providing most of the agricultural research, extension, and other technical services.

Dr. H. Kamuzu Banda, in his dual roles as Life President and Minister of Agriculture, has not only played a major role in establishing and maintaining the agricultural focus of Malawi's development strategy, but has also given detailed and steady attention to policy decisions within the ministry which affect smallholder agriculture. In addition to approving all major ministry appointments, he reviews major policy and pricing decisions, and it is he who announces the new commodity prices each fall.

Within the Ministry of Agriculture, both development and execution of policy are the responsibility of senior staff: the Principal Secretary and his Deputy, the Controllers, Department Heads and ADD Directors. The ministry is currently organized into 4 units: the Departments of Agriculture (extension), Agricultural Research, Animal Health and Industry, and General Administration, including planning. The managers of the eight regional Agricultural Development Districts (ADDs) hold the same rank as department heads, and report to the Principal Secretary through the Controller of Agricultural Services (See Chart, MOA).

This group meets regularly to harmonize their policy positions, and work out practical problems in implementation. The decision making style

MINISTRY OF AGRICULTURE ORGANIZATION CHART HERE (FIGURE II-1)



appears to be strongly problem oriented and consensual. Problems appear to be identified through discussion; information is sought and brought to bear; differing points of view are heard; a decision is eventually reached and all participants are then responsible for executing it. There is respect for authority within this process; open dialogue is primarily among peers. There appears to be strong commitment to consensus, and care is taken not to override the views or interests of colleagues. Such a system tends to be conservative, because power rests with the pooled the knowledge of the group, rather than with an expert. Until now, this method has served Malawi well--permitting change, while minimizing risk.

The success of this decision-making style is, in part due to the efficiency of the feedback systems upon which it rests. Information moves from the farm level to the ministry primarily through extension, which is strongly farmer identified. Yet there is substantial redundancy in the system, because both ADMARC and the National Congress Party (NCP) also have representatives at the local level who move information upwards to the national level through their own organizations, where it can be meshed into policy decisions.

More importantly, these institutions provide checks and balances on one another at the local level. All three are responsible for dissemination of information on yearly price changes. Party members are also given the new annual production guide each year at their national meeting, and encouraged to share the information at the village level. Although their knowledge may not be as detailed as that of the extension agent, they do provide an alternative source of information. Because

farmer's groups include large numbers of party members, the party serves to onitor both extension and ADMARC. This alternate channel gives farmers an effective channel for feedback on the technology system's performance.

Finally, it is customary in many ADDs for the extension service to place an agent at the ADMARC depots during the marketing season. Their role is not only to assist the farmers in any disputes that might arise, but also to monitor the timely arrival of inputs, and to communicate any supply problems as quickly as possible through the relevant offices. In the Mazuzu ADD, for example, transportation of inputs is particularly difficult.

Long distance communication is equally a problem, but the ADD offices have one of the few reliable systems. If a contracted trucker does not arrive on schedule, extension officers notify the ADD office, which in turn notifies the ADMARC office in Blantyre, so that alternative arrangements can be made as quickly as possible. Because there is common agreement on the objectives being served, the redundancy provided by these parallel channels of communication serve to improve the performance of Malawi's technology transfer system.

Planned Changes in the Ministry

As diversification proceeds, and the economy becomes more dependent on rapidly changing world markets, the number, the pace and the technical complexity of necessary decisions is likely to increase. In response to this emerging reality, grants, loans and government revenue are being invested in graduate training for many ministry officials.

In particular, substantial training resources are being invested in

creation of a new planning department. Until recently there was little institutionalized planning capability within the ministry. The planning office was small, and it's charge was primarily to assist in the development of projects. As the economy moves toward more diversified and monetized agriculture, this office is being expanded into a planning department with six sections: marketing, planning, project preparation, evaluation, data processing and survey statistics.

The charge of the expanded department is to organize and make available the information necessary for policy, planning and day-to-day decision making. There will be a substantial increase in the number of economists on the staff. As noted earlier, these economists belong to the Economic Common Service, and have a somewhat different training and career path than other ministry staff. The success of the expanded office will hinge on its ability to produce information and plans that are seen as relevant by the senior officials who, in the Malawian context, are the effective policy makers.

SMALLHOLDER AGRICULTURAL POLICIES

The general thrust of ministry policy over the years has been to support a gradual transition from traditional farming to more intensive farming, including the greater use of purchased inputs to increase productivity. Smallholder research has focused on crops such as maize, groundnuts, cotton, rice and tobacco, where improved seed and fertilizers, purchased with revolving credit funds, can provide greater productivity per hectare. Given the increasing population pressure on a limited land base, such a strategy has much to recommend it.

The disruption of rail transportation through Mozambique in 1983/84, combined with earlier increases in gasoline and fertilizer prices, has increased the cost of pursuing this strategy substantially. The Ministry's response has taken two forms. In collaboration with the World Bank, they have undertaken an investigation of their comparative advantage in agricultural export crops, given the current transport realities. The results of the study are to be used in planning the allocation of scarce resources, with respect to such things as transport, foreign exchange and fertilizer, to best advantage.

Within the ministry an intensive dialogue is also in progress about the best ways of supporting the production of the majority of smallholders who cannot afford high levels of capital inputs in the foreseeable future. For example, there is renewed interest in integrated livestock and cropping systems, including the use of natural fertilizers such as crop residues and manures amd in the intercropping of maize with pulses and groundnuts. During the annual senior staff policy retreat in August of 1985, it was decided to focus more intensively on these and other areas over the next few years.

Government Expenditures on Agriculture

Government support for research and extension activities and rural infrastructure development is especially essential for agricultural development in low income countries. Well developed objectives, strategies and policies are not useful unless supported by financial resources for implementation. The government of Malawi has two budget accounts, the

revenue (recurrent) account, which is totally supported by government revenues, and the development account, which involves about 90% external financing through grants and loans. Tables II-5 and II-6 below reflect the government's expenditures for agriculture, livestock, fisheries and forestry as a percentage of total government expenditures in each account for the years 1980/81 through 1985/86. These data show that agriculture's share of total government expenditures on the revenue account has been increasing since 1980/81. These increases represent about 7.5% annual increases for extension and 5% annual increases for research in real terms during this period. The development account represents donor financed projects and reflects the level of expenditures that agriculture and the rural sector has received. The only ministry receiving a higher percentage of government resources is Education.

Table II-5

Government Investment in Agriculture and
Natural Resources - Revenue Account

Year	Total Recurrent Expenditures (K million)	Agriculture and Natural Resources (K million)	Percent
1980/81	183.67	17.44	9.5%
1981/82	231.86	22.58	9.7
1982/83	260.70	24.64	9.5
1983/84	289.03	29.61	10.2
1984/85*	363.93	40.88	11.2
1985/86**	387.67	48.28	12.5
6 YEAR AVERAGE			10.4%

Source of Data: Malawi Government (1985). Economic Report 1985, p.87.

Table II-6

Government Investment in Agriculture and
Rural Development - Development Account

Year	Total Development Expenditures (K million)	Agriculture, Vet. Fisheries & Forests (K million)	%	Roads and Bridges (K million)	%
1980/81	174.90	23.18	13.3%	18.04	10.3%
1981/82	124.17	27.87	22.4	26.05	21.0
1982/83	139.58	30.52	21.9	21.88	15.7
1983/84	142.91	37.31	26.1	15.19	10.6
1984/85*	134.15	27.36	20.4	27.60	20.6
1985/86**	155.64	29.15	18.7	28.72	18.5
6 YEAR AVERAGE			20.5%		16.1%

- - - - - - - - - - -
*Revised Estimates
**Estimates
- - - - - - - - - - -

Source of Data: Malawi Government (1985). Economic Report 1985, p. 89-90.

The Ministry of Agriculture's share of the national budget is arrived at through a dual process. The Ministry of Finance assigns each ministry an annual budget figure based on available resources. At the same time, within the ministry itself, each unit prepares a projected budget, based on current expenditures and planned increases. These budgets are progressively aggregated until they reach the senior decision making group, which attempts to reconcile them with the budget allocation given by Finance. Then, if there are strong arguments to be made for additional funds, Finance and Agriculture officials sit down together and work it out. MOA personnel feel that they are in a strong bargaining position in these discussions, given the importance of agriculture, and since the President for Life is also Minister of Agriculture.

As shown in Table II-7, the Departments of Agricultural Research (DAR) and Agriculture (DOA) within the MOA have received a fairly stable proportion of the revenue budget during this period, averaging about 5% of total government expenditures. The DOA's proportion of the development budget was more volatile, ranging from 8.9% of the development budget in 1980/81 to 21.6% in 1983/84. Because the development accounts are primarily donor funded, most of this variability can be explained by the lumpiness of donor activity and their grant process. For example, the capital investments for a five-year project may be concentrated at the beginning of the project.

Table II-7
GOVERNMENT INVESTMENT IN AGRICULTURAL RESEARCH
AND DEVELOPMENT (INCLUDING EXTENSION)

YEAR	REVENUE ACCOUNT (RECURRENT COSTS)*		DEVELOPMENT ACCOUNT (PRIMARILY DONOR FINANCED)		TOTAL EXPENDITURES	
	CURRENT	DEFLATED**	CURRENT	DEFLATED**	Current	Deflated
	MILLION	KWACHA	MILLION	KWACHA	MILLION	KWACHA
1976/77	3.31	N.A.	8.92	N.A.	12.23	n.a.
1977/78	4.25	N.A.	12.55	N.A.	16.80	n.a.
1978/79	5.76	5.76	10.71	10.71	16.47	16.47
1979/80	6.78	6.04	15.10	13.46	21.88	19.50
1980/81	7.44	5.62	15.48	11.69	22.92	17.31
1981/82	8.43	5.80	20.73	14.27	29.16	20.07
1982/83	14.80	9.16	22.61	13.99	37.41	23.15
1983/84	15.74	8.49	30.93	16.67	46.67	25.16
1984/85	17.36	8.78	21.26	10.75	38.62	19.52
1985/86	20.45	N.A.	24.45	N.A.	44.90	n.a.

- - - - - - - - - -

SOURCE OF DATA: MALAWI GOVERNMENT. APPROVAL ESTIMATES OF EXPENDITURE ON REVENUE ACCOUNT FOR THE FINANCIAL YEARS 1978/79 THRU 1985/86; MALAWI GOVERNMENT. APPROVED ESTIMATES OF EXPENDITURES ON DEVELOPMENT ACCOUNT FOR FINANCIAL YEAR 1982/83, P. VI AND MALAWI GOVERNMENT. ECONOMIC REPORT 1985, P. 89. GOVERNMENT PRINTER, ZOMBA, MALAWI.

*NOTE: INCLUDES ONLY AGRICULTURE DEPARTMENT EXPENDITURES, INCLUDING AGRICULTURAL RESEARCH, AGRICULTURAL DEVELOPMENT (EXTENSION, CREDIT, LAND HUSBANDRY AND WOMEN'S PROGRAMMES) AND EXTENSION AIDS BRANCH.

NOTE: DATA FOR 1984/85 AND 1985/86 ARE REVISED ESTIMATES AND BUDGETED ESTIMATES, RESPECTIVELY.

**NOTE: 1978 GDP DEFLATER IS USED. SEE MALAWI GOVERNMENT (1985). ECONOMIC REPORT 1985, P. 8.

Another important measure or indicator of government investment in agricultural development is to relate government agriculture expenditures to the agricultural gross domestic product (AGDP). Table II-8 relates government expenditures in the Ministry of Agriculture, including agricultural research, extension, credit and land husbandry activities to AGDP. Between 1980 and 1985 about 2.53% of AGDP was spent on recurrent expenditures from the revenue budget and 4.65% of AGDP was spent on capital development investments. However, as will be dicussed in the Transfer chapter, some development account resources are actually being spent on recurrent expenses. Most of these development expenditures were related to the aggressive development plans for each Agricultural Development Division (ADD).

Table II-8
GOVERNMENT INVESTMENT IN AGRICULTURAL
RESEARCH AND DEVELOPMENT, RELATED TO AGRICULTURAL
GROSS DOMESTIC PRODUCT AT 1978 CONSTANT FACTOR COST

YEAR	DEFLATED AGDP	REVENUE ACCOUNT DEFLATED K	%	DEVELOPMENT ACCOUNT DEFLATED K	%
1980	284.1	6.04	2.13%	13.46	4.74
1981	260.7	5.62	2.16	11.69	4.48
1982	278.7	5.80	2.08	14.27	5.12
1983	290.6	9.16	3.15	13.99	4.81
1984	308.8	8.49	2.75	16.67	5.40
1985	313.9	8.78	2.80	10.75	3.42
6 YEAR TOTAL	1736.8	43.89		80.83	
6 YEAR TOTAL	289.5	7.32	2.53	13.47	4.65

- - - - - - - - - - -

SOURCE OF DATA: MALAWI GOVERNMENT. APPROVAL ESTIMATES OF EXPENDITURE ON REVENUE ACCOUNT FOR THE FINANCIAL YEAR 1978/79 THRU 1985/86; MALAWI GOVERNMENT. APPROVED ESTIMATES OF EXPENDITURE ON DEVELOPMENT ACCOUNT FOR FINANCIAL YEAR 1982/83, P. vi AND MALAWI GOVERNMENT. ECONOMIC REPORT 1985, P. 89. GOVERNMENT PRINTER, ZOMBA, MALAWI.

With respect to overall investments in technology development and transfer, it appears that Malawi is investing about 0.73% of AGDP in agricultural research, and another 2.2% in knowledge transfer (from both revenue and development accounts). Agricultural research expenditures appear to be increasing at about 5%/year in real terms, while DOA expenditures are increasing at about 7.5%/year in real terms.

Government Commitment to Development of Rural Infrastructure

The government has invested substantial amounts of the development budget in rural infrastructure over a sustained period of time. In the first 15 years after independence, investment was most intense in the four original Rural Development Projects (Lilongwe, Lakeshore, Shire Valley and Karonga.) These were all multi-component projects that included credit, agricultural research, extension, and crop marketing facilities, as well as rural roads, water supply systems, health centers and community development activities. These projects were resource intensive, with investments per (benefitting) farm household
ranging from US$ 695 (in 1978 terms) for the Shire Valley to US$ 2,700 in Karonga-Chetipa (World Bank, 1982).

Since 1978, the government has instituted the National Rural Development Program to extend this infrastructure more widely throughout the country. The combined resources of Malawian government revenues, multilateral and bilateral loans and grants are being used to bring increased investments in rural infrastructure to the entire country by 1990.

One measure of government commitment to the rural infrastructure necessary for agricultural development is commitment to construction and maintenance of rural roads. Lack of roads and marketing outlets may constrain the ability or inclination of some farmers to adopt new technology, particularly that related to cash and export crops. Most smallholder farmers in Malawi have no access to motorized transport and a lack of roads causes animal drawn cart transport to be difficult and slow. Roads not only give farmers access to input supplies and produce markets, but also gives extension agents more mobility over longer periods of time. Not only does easier transportation facilitate movement of crops into national and international markets, it also gives more access to off-farm employment, and makes rural living generally more attractive. From a base of 200 miles of bitumen road at independence, Malawi has expanded to 2165 kilometers of paved roads in 1983 (see table II-9).

As shown in Table II-5, Malawi annually invests about 16% of its annual development budget in roads and bridges. In 1984 there were 9.03 kilometers of road per 1,000 rural households. This is a substantial investment in rural infrastructure, and transportation between major population centers is now well established, except in the north. However, it must be noted that most rural roads in Malawi are basically dry weather tracks and many become unusable during the rainy season.

Table II-9
Inventory of Roads By Type

Year	Kilometers of Roads			
	Bitumen	Gravel	Earth	Total
1964	431	742	8955	10,128
1970	447	751	9504	10,703
1975	1242.5	533	8926.5	10,702
1980	1904.5	254	8604.5	10,763
1983	2165.6	528.7	8847.4	11,541.7

Source: National Statistical Office (1984). Malawi Statistical Yearbook, 1982, Zomba, p. 95-96.

Markets

In Malawi, there are active private markets which serve local consumers and also distribute perishables such as fruits, vegetables and fish nationally. In these private markets, prices vary both between seasons and between regions of the country, permitting some development of regional comparative advantage. They also provide a mechanism for national and international marketing of commodities such as pulses, where demand is high and ADMARC's floor price is low.

Most cereals and cash crops are sold to the Agricultural Development and Marketing Corporation (ADMARC), the national marketing parastatal which buys all offered commodities for immediate cash at a pan-national price. ADMARC also provides production inputs, such as seeds, fertilizer and pesticides. These may be purchased in cash, or with credit extended through farmer clubs in the Agricultural Development Districts (ADDs).

Reliable access to input supply points as well as markets to sell surplus output is an important factor in expanding production. In 1981, 76.5% of rural households were within 8 km of an (ADMARC) input supply and

marketing depot (see Table II-9). The goal is to have all households within 10km by 1990 (National Sample Survey of Agriculture, 1980/81).

The seasonality of the roads makes ADMARC's work difficult, particularly since many of their depots are seasonal and they have inadequate storage facilities for inputs and produce. Sometimes inputs do not arrive before the rains and it is difficult to meet farmer demand; there may also be some spoilage of both inputs and produce due to inadequate storage facilities and/or secondary roads. Yet, despite the magnitude of the effort, as well as tranportation and geographical difficulties, Malawi's marketing system appears to work reasonably well.

Table 10
Density of ADMARC Distribution Facilities
and Farmer Proximity to Markets

District	Number of ADMARC Facilities (Est.)[1]	Farm Households Per Facility	Cropped Hectares Per Facility	Proximity to ADMARC Markets < 2 Km	> 8 Km
				--- percent ---	
Karonga	95	272	279	41.6	6.9
Mzuzu	354	256	318	29	9.7
Kasungu	123	945	1,869	13.2	38.9
Salima	89	773	536	37.5	2.2
Lilongwe	136	1,215	1,557	12.6	18.4
Liwonde	214	1,077	867	14.5	20.6
Blantyre	195	975	698	15.0	38.5
Ngabu	68	781	1,078	16.4	6.1
MALAWI	1,274	788	838	17.6	23.4

[1] Because of the difficulty in determining location and nature of depots, the figures will remain an estimate, although a fairly accurate one. What the data can't reveal are the areas in which distribution of supply points is adequate, and this is reported to be the case in project areas.

Sources: ADMARC Market Code List, 1985/86; National Sample Survey of Agriculture, 1980/81.

PRICING POLICY

Two aspects of output prices are important in influencing farmers to adopt new technologies and recommended practices: price uncertainty and the relationship between input costs and output prices. When farmers assume all the risk from price fluctuations, and/or where input costs are too high to assure a reasonable profit, adoption of new technology can be expected to be low. In Malawi, marketing risks have been reduced by instituting a policy whereby ADMARC sells inputs and purchases all surplus production at pan-national prices that are announced well before the planting season.

When the farmgate prices of different commodities are raised to profitable levels, it is expected that production would increase, because output and input prices are reliable. Farmers in Malawi appear to be more price responsive than farmers in many African nations because they operate with sufficient information from a reliable and well organized marketing system. Over the past five years they have demonstrated great ability to shift their production activities quickly and efficiently in response to changing price signals and profit margins.

Major crop prices and prices of inputs necessary for smallholder production are set by a government pricing commission, upon recommendation of ADMARC and the Ministry of Agriculture. The prices are initially developed in the planning department of the Ministry; they are then reviewed and forwarded to the pricing commission by ADMARC. Both the Ministry of Agriculture and ADMARC are very short on staff to perform these functions. Until recently, there were a small number of economists in the

Ministry and turnover rates were high because demand for their skills far exceeds supply. ADMARC does not have in-house economists.

Maize prices are now set between import and export parity, at a level which takes into account the farmers costs of production and the need for price incentive to assure national self-sufficiency. In 1981, farmgate maize prices were well below those of other countries in the region. At the outset of a regional drought the producer's maize price was increased by 64%, and the incentive was sufficient to provide the national reserve of 180,000 MT, as well as a substantial surplus for export in 1983 and 1984.

As shown in Table II-11, the rise in maize prices and the strong production response appears to have resulted in reduced production of other important commodities in 1982 and 1983. Therefore, between 1983 and 1985, the prices of cotton, groundnuts and tobacco were also raised to reestablish a balanced production pattern. This realignment of cropping patterns through use of price incentives is still in process. The current gains in maize production appear to be largely the result of continued movement out of other crops. Pulse, groundnut and rice production in 1984 are all considerably below 1980 levels (see Table II-11).

Table II-11

ADMARC Producer Prices and Procurements, 1978-1983
(Average prices in Kwacha per Metric Ton, Procurements in Metric Tons)

	1978	1979	1980	1981	1982	1983	1984
Maize							
price	52	52	66	66	111	111	120
procurements	120,617	82,171	91,888	136,647	246,062	244,937	249,400
Groundnuts							
price	200	302	308	307	327	497	523
procurements	11,130	24,296	31,418	19,494	10,432	10,218	9,866
Pulses							
price	150	182	117	119	121	122	126
procurements	10,436	6,706	10,596	7,202	5,791	3,185	5,556
Tobacco							
price	475	412	423	481	446	741	815
procurements	23,742	19,541	11,341	12,755	8,794	9,279	19,162
Rice							
price	98	99	101	100	109	127	139
procurements	30,816	20,487	17,498	14,682	12,543	8,503	9,441
Cotton							
price	213	218	218	214	269	363	400
procurements	24,218	22,411	23,114	21,739	14,800	13,368	32,122

Source: Compiled from National Statistical Office, Monthly Statistical Bulletin, November, 1984, p. 4.

In 1985, with reduced export demand due to better weather in neighboring countries, the national maize reserve has increased from about 115,000 MT in 1983 and 150,000 MT in 1984, to an estimated 230,000 MT in 1985. Total estimated value of the reserve was K12.6 and 18.3 million MK in 1983 and 1984 and is currently considerably higher. Since this reserve is all held by ADMARC, the investment bound up in this strategic reserve reduces the operating capital that ADMARC needed to purchase the 1985 crop. This cash flow problem slowed down ADMARC's 1985 purchases from farmers, which could

affect credit repayment rates.

The net effect of these price rises in the 1980's is that total agricultural production purchased by ADMARC rose from a quantity of 215,700MT, valued at K27.8 million in 1981, to 376,600 MT, at a value of K72.8 million in 1984. The majority of this increase came from maize, followed by tobacco and cotton.

The continued strong farmer response to higher maize prices, combined with fluctuating and uncertain export demand, may signal a need to estimate domestic and international demand when arriving at future producer prices for maize. At current '84 prices, maize was sold by ADMARC at a slight loss in the domestic market, and close to the break even point in the international market, when transportation and administrative costs are taken into account.

ADMARC's net trading profit on smallholder tobacco was K18.6 million in 1984 and was estimated at K15.8 million for 1985. As shown in Table II-12, some of this profit is used to subsidize the purchase price of other crops, particularly maize and rice. Producer prices for tobacco are set at levels which provide adequate returns to farm labor similar to those of alternative crops, so that food crop production can be adequately maintained. Tobacco is the one crop where production quotas are assigned to farmers, in response to estimated demand on the world market, in order to protect the level of prices.

Table II-12

Abbreviated Estimated ADMARC Trading Account 1984/85

Crop:	Cotton	Groundnuts	Tobacco	Maize	Rice	Gen. Produce	Total
Purchases, 1,000 MT	32.0	11.0	19.1	290.0	11.0	9.0	372.1
Value mill. MK	12.7	6.3	15.5	35.4	1.9	1.4	73.2
Local sales 1,000 MT	27.6	7.0	19.1	150.0	9.0	4.2	216.9
Exports	4.4	4.0	--	150.0	2.0	2.0	162.4
Local sales value m MK	13.2	5.0	40.0	23.2	2.4	1.6	85.5
Export sales	9.9	4.6	--	33.4	1.1	0.3	49.3
Total sales value m MK	23.1	9.5	40.0	56.7	3.5	1.9	134.8
Direct expenses * m MK	5.9	2.4	7.3	16.2	2.0	1.3	35.1
Adminis. expenses m MK	1.4	0.4	1.4	3.8	0.5	0.3	7.8
Total expenses m MK	7.3	2.8	8.7	20.0	2.5	1.6	42.9
Net trading profit m MK	3.1	0.4	15.8	-0.3**	-0.9	1.1	17.4

Source: ADMARC
* including selling expenses
** including change of stock

The price of some smallholder inputs are also subsidized, fertilizer being by far the most costly. The magnitude of the fertilizer subsidy is significant. Some estimates place the subsidy, or amount of expenses from buying and then selling a ton of 20:20:0 to smallholders farmers at $151.68 in 1983 (source). The recent sharp increases in fertilizer transportation costs, due to closing of the Mozambique transport corridors, are still being absorbed by the government. However, the subsidy on fertilizer is to be gradually phased out over the next few years. Already, subsidies on 20-20-0 have been reduced from 33% in 81/82 to 26% in 84/85. Fertilizer prices will also be reduced through importation and sale of higher intensity fertilizers, which will reduce transport costs. As shown in Table II-13, the output price to input price ratio for maize and fertilizer has been steady to slightly increasing from 1977/78 to 1984/85.

Table II-13

Ratio of Price: Maize to Fertilizers

Year	(2) Average Cost to Farmer per kg of Nutrient	(3) Official Beginning Price of Maize K/kg (Kwacha)	(4) Ratio of Maize[1] Price to Fertilizer Nutrient Price
1977/78	0.521	0.052	0.100
1978/79	0.513	0.052	0.101
1979/80	0.503	0.052	0.103
1980/81	0.609	0.056	0.092
1981/82	0.707	0.056	0.079
1982/83	0.798	0.111	0.139
1983/84	0.906	0.122	0.135
1984/85	1.043	0.122	0.117

[1]Farmer price of maize (K/kg) divided by average price kg of nutrient, (4) = (3) (2)

A different conclusion is reached when price increases for other crops are compared to increases in fertilizer prices (see table II-14). While maize prices have increased somewhat more rapidly than fertilizer prices, other commodity prices have risen less rapidly, particularly for rice, pulses, tobacco and cotton. It is unclear what effect these trends have on fertilizer use, but these findings may also help explain recent declines in the production of some commodities.

Table II-14
Comparison Between Increases in Cost of Fertilizer
and Increases in Selected Commodity Prices
1977/78 and 1984/85

	Cost (k/kg) 1977/78	Price (k/kg) 1984/85	Percentage Increase
Fertilizer	0.521	1.043	100%
Maize	0.052	0.120	131
Groundnuts	0.200	0.577	189
Pulses	0.117	0.182	56
Tobacco	0.475	0.815	72
Cotton	0.213	0.400	88
Rice	0.098	0.139	42

The projected increases in fertilizer price when subsidies are removed, may change the current situation. The present price of fertilizer appears to provide an acceptable profit margin for hybrid maize and the main constraint to expanded use has been limited access to credit. As shown in Table II-15, the projected removal of fertilizer subsidies, all other things remaining equal, bring returns to labor for hybrids below those of local corn, thus substantially changing the incentive structures in smallholder production.

Table II-15

Estimated Returns to Hybrid and Local Maize Production in 1984/85 and 1985/86 with Fertilizer subsidies and in 1985/86 without subsidies

	Hybrid with subsidies			Hybrid w/out subsidies		Unfertilized Local Maize		
	Inputs Outputs (kg/ha)	1984/85 Cost/ Value (MK)	1985/86 Cost/Value (MK)	Inputs Outputs (kg/ha)	1985/86 Cost/Value (MK)	Inputs Outputs (kg/ha)	1984/85 Cost/ Value (MK)	1985/86 Cost/ Value (MK)
Yield	3325			2685		1010		
Value of output		405.65	425.60		343.68		123.22	129.28
Variable Cash Costs								
Seed		25.00	27.50		17.50		4.00	4.40
Fertilizer[f]							0.00	0.00
20-20-0	140	49.00	57.40	91	51.78			
CAN	140	43.40	53.20	91	43.04			
Chemical Costs		8.00	8.80		8.80		0.00	0.00
Purchasing Costs[g]		5.60	6.16		4.00		0.00	0.00
Marketing Costs[h]		51.41	60.96		49.23		0.00	0.00
Total Cash Costs		186.41	214.02		184.35		4.00	4.40
Gross Margin Per Hectare		219.24	211.58		159.33		119.22	124.88
Less Returns to Captial		19.65	22.96		20.27		.60	.66
Returns to Family Labor		199.59	188.62		139.06		118.62	124.22
Mandays of Labor Required	140			130		106		
Return per Manday		1.43	1.35		1.07		1.12	1.17

Source: Zallat: 1985, Economic and Technical Analysis of Proposed Reforms in Fertilizer - Report to USAID, Malawi.

Credit Availability

Table II-16 presents data on the volume of credit, by ADD for the period 1977-78 through 1984-85. For the country as a whole there has been a sharp increase in credit use, an average annual increase of 63 percent, or 504 percent increase over the entire period. Because credit is provided through the regional Rural Development Projects its availability differs according to the levels available in that project area. Areas with long-term donor assistance have larger credit funds at their disposal. Ngabu, which is presently without external funding, has increased only 25 percent during this period, while Blyantyre, starting from a much lower base, has increases more than 2500 percent.

Table II-16

Volume of Credit at A.D.D. Level, 1978/79 to 1984/85

District	Loaned (in Thousands of mk)								Percent Change
	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1977/78 to 1984/85
Karonga	187.5	147.5	204.4	270.4	256.2	240.3	319.7	579.4	209
Mzuzu	NA	NA	344.3	588.6	735.5	1,408.0	1,827.1	2,110.3	512
Kasungu	26.8	61.1	105.9	252.9	691.0	1,259.0	2,163.9	3,648.0	1,350
Salima	600.6	358.9	471.6	610.9	451.1	660.8	791.6	1,216.7	102
Lilongwe	1,412.8	1,704.7	2,003.0	3,343.5	2,150.5	3,481.7	4,683.8	6,143.1	335
Liwonde	98.9	90.7	233.5	304.8	422.5	714.4	864.5	1,117.6	1,030
Blantyre	30.0	57.8	97.3	166.7	275.3	627.8	671.2	802.9	2,574
Ngabu	285.1	208.3	228.2	284.6	177.7	157.3	263.4	357.1	25
MALAWI	2,641.7	2,629.0	3,688.3	5,822.2	5,169.7	8,549.3	11,585.2	15,975.1	504

53

The National Rural Development Program, initiated in 1978, is intended to gradually equalize the credit available. However, the country as a whole is starting from a very small base of approximately 12.6 Mk per farm household in 1984-85. Because there is a very strong demand for credit, farmers' clubs are used are used for disbursing and collecting funds. Repayment rates are very high, ranging between 90 and 98%.

Most credit is given in seasonal loans, at a 10% flat rate of interest which is a 15% effective annual interest rate on a 9-month loan. Loans are disbursed in kind through ADMARC, with improved seed, fertilizer and other inputs assembled in production packages. Some credit is also given in longer term loans for purchase of equipment such as oxen, oxcarts, and farm implements. It is estimated that only about 10-15% of farmers are receiving credit and average loan amounts vary from about 30-90 kwacha/farmer. The availability of credit at the Add level is contingent on external RDP funding.

A final measure of the expanded availability of agricultural credit is found in Table 2-17. This table compares the amount of credit available to smallholders with the total amount of private credit in Malawi. As can be seen from this table, agricultural credit is expanding rapidly both in total amount and as a percentage of total private credit. In 1985, it is estimated that K16 million would represent about 6% of total private credit, a substantial increase from 1980 when only K3.7 million was loaned which represented only 2% of private credit.

Table II-17

Smallholder Agricultural Credit Compared with Total Private Credit

Year	Total Private Credit Millions of Kwacha	Smallholder Agric. Credit Millions of Kwacha	Percent
1978	122.25	2.64	2.2%
1979	170.75	2.63	1.5%
1980	182.40	3.69	2.0%
1981	191.79	5.82	3.0%
1982	219.03	5.17	2.4%
1983	254.69	8.55	3.4%
1984	228.16	11.59	5.1%
1985		15.98	

- - - - - - - - - - - -

Source of Data: National Statistical Office (1985). Montly Statistical Bulletin, November, 1984. Zomba, p. 16.

Imports of Agricultural Inputs

Imports of fertilizer and agricultural chemicals appear to be given priority access to foreign exchange and transportation, which is consistent with governmental emphasis on agricultural production. Table II-18 documents the increase in fertilizer imports from 1970 through 1984, and the distribution of this material between the smallholder (ADMARC sales) and the estate sector. Both sectors have expanded their use of fertilizer in more or less equivalent amounts. However, as shown in Table II-19, the average amount of fertilizer available per hectare varies greatly.

Table II-18
Fertilizer Imports and Usage in Malawi

Year	Total Fertilizer Imported		Fertilizer Usage* ADMARC Sales		Estate Sector	
	Tons	Value (k million)	Tons	%	Tons	%
1970	36,569	1.845	15,550	42.5	21,019	57.5
1971	72,087	3.272	20,725	28.7	51,362	71.3
1972	58,953	3.019	24,831	42.1	34,122	57.9
1973	43,412	3.233	24,054	55.4	19,358	44.6
1974	40,548	5.439	31,870	78.6	8,678	21.4
1975	80,504	15.265	14,908	18.5	65,596	81.5
1976	72,504	9.755	21,530	29.7	50,974	70.3
1977	78,278	11,150	30,661	39.2	47,617	60.8
1978	103,398	14,205	44,674	43.2	58,724	56.8
1979	81,225	11,651	44,651	54.6	36,847	45.4
1980	80,800	14,921	49,142	60.8	31,658	39.2
1981	119,672	26,012	64,449	53.9	55,223	46.1
1982	120,471	24,969	56,307	46.7	64,164	53.3
1983	120,186	32,434	57,763	48.1	62,423	51.9
1984	135,685	46,957	67,000*	49.4	68,685	50.6

*Fertilizer usage by estate sector was estimted to residual between total imports and amount sold by ADMARC.

Source of Data: National Statistical Office (1984). Monthly Statistical Bulletin, November, 1984, Zomba, p.2; Ministry of Agriculture (1984). Guide to Agricultural Production in Malawi 1984-85, p.4 and ADMARC (1981, 1984). Annual Accounts and Report.

Table II-19
Estimates of Fertilizer Usage in Kilograms per Hectare on Smallholder and Estate Land

Year	Smallholder Sector	Estate Sector
1970	11.7 kg/ha	42.9 kg/ha
1975	13.7	75.8
1980	36.9	64.6
1981	48.4	112.7
1982	42.3	130.9
1983	43.4	127.4
1984	50.3	140.2

*Note: Average usage of fertilizer is based on estimates of land being cropped by smallholders = 1,332,000 hectares and by estates 490,000 hectares (controlled, but not necessarily cropped).

The recent worldwide resession, combined with rapidly increasing transportation costs, caused disruptions in Malawi's ability to import fertilizer and distribute it to the farmers in a timely manner. In April of 1984, with contributions of US$ 8.90 millions from IFAD and MK50 million from the government and MK 1.26 from ADMARC, a smallholder fertilizer fund was established "to ensure sufficient and timely supply of fertilizer and alleviate financial strain on ADMARC." In general, policy giving agricultural inputs priority in foreign exchange for imports has been supportive of agricultural development and technology adoption.

Imports of Agricultural Products

In an effort to keep food prices low for consumers, some countries may import large amounts of food , either commercially or on a concessional basis. Under most circumstances, these imports depress the price of locally produced commodities. When this occurs, it constrains the adoption of technology and limits the performance of the overall production system. Malawi's food imports are restricted to a few items where they are not self-sufficient. Table II-20 outlines the value of agricultural imports for selected years. Overall, it is estimated that agricultural imports represent about 2% of AGDP.

Table II-20
Value of Agricultural Imports (MK)

	1979	1980	1981	1982
Wheat or Wheat Flour	1,905,000	5,652,000	4,332,000	5,726,000
Edible oils	1,977,000	1,978,000	1,554,000	859,000
Cotton products	1,783,000	2,406,000	1,895,000	2,032,000

Source: National Statistical Office, Annual statement of external trade

Very little concessional food aid is imported into the country. In 1982, the UNDP donor accounts show only 1,500 tons of wheat from France, and 60,200 tons of milk powder and butter from the World Food Program. Malawi has exported a considerable amount of its own grain as concessional food aid to neighboring countries in recent years under funding by various donors. These amounts are included in the total export accounts. In general, food and agricultural imports are not constraining the development of production agriculture. However, import substitution of wheat and edible oils may be a possibility for diversification.

Export of agricultural products

Agricultural exports are the backbone of the Malawian economy and governmental policy is directed to maximizing their value to the total economy. Table II-20 provides an overview of Malawi's domestic exports for the period 1980-85. The value of agricultural commodities represents well over 90% of total exports during this period. The low cost of labor, combined with favorable agro-climatic conditions have combined to give Malawi a comparative advantage in the export of tobacco and tea on the world market.

Table II-21
Exports by Main Commodities 1980-85
(K million)

	1980	1981	1982	1983	1984[1]	1985[2]	% Change 1984 on 1983
Agricultural Crops:							
Tobacco	100.8	99.4	145.8	136.7	193.8	183.7	41.8
Tea	29.8	30.6	45.3	55.9	112.5	118.6	101.3
Sugar	37.7	56.7	24.3	27.1	29.2	45.2	7.7
Groundnuts	15.9	10.6	4.6	2.9	2.4	4.8	17.2
Rice	3.0	3.1	1.7	0.2	0.9	2.1	350.0
Cotton	4.5	1.5	0.3	--	--	17.3	0.0
Pulses (beans, peas, etc)	1.8	2.7	2.0	9.6	4.3	4.8	55.2
SUBTOTAL	193.5	204.6	224.0	232.4	343.1	376.6	47.6
Other Crops[3], including Manufacturers	24.8	27.8	25.0	32.8	78.8	68.6	140.2
Total Domestic Exports	218.3	232.4	249.0	265.2	421.9	445.4	59.1

[1]Estimate [2]Forecast [3]Includes other crops such as maize, coffee, macadamia nuts, tung oil and so forth.

Source: Malawi Government (1985). Economic Report 1985, Office of the President and Cabinet, Zomba: Government printer, p.16.

In the past few years during a regional drought, maize has also been a major export to neighboring countries. In 1984, the value of exported maize was K49.3 million or 11.7% of total domestic exports, which put it in third place behind tobacco and tea. [Note: since maize is not a traditional export crop, its value is included in the "other" category in Table II-21.]

There is considerable world demand for confectionary groundnuts, but lack of price incentives and access to more productive technology has reduced production as farmers shifted to more profitable maize. Groundnut prices were sharply raised in 1983 and again in 1984, but farmers still have not responded significantly to these price incentives. There appear

to be some delays in getting improved seed and pesticides to smallholders which is slowing recovery in groundnut production and export.
Oilseed groundnuts have good potential for import substitution both in bulk, and processed as oil, as well as for export. Cotton processed in country, as well as exported in bulk, also has potentially good returns. Malawi's advantage is also high in production of crops limited to specific areas, such as Macadamia nuts, cashews and coffee. The government is currently considering ways to increase exports. It is clear that the Government of Malawi is striving to encourage exports and provides pricing incentives and marketing services to realize this objective.

TECHNOLOGY DEVELOPMENT AND THE AGRICULTURAL RESEARCH SYSTEM IN MALAWI

Introduction

The major institutions that conduct agricultural research in Malawi are (1) the Department of Agricultural Research (DAR) and the Department of Veterinary Services (DVS) in the Ministry of Agriculture (MOA), (2) the Tobacco Research Authority (TRA), (3) the Tea Research Foundation (TRF), and (4) Bunda College of the University of Malawi. In addition, a small amount of sugar research is conducted by one of the large sugar estates for the Sugar Corporation of Malawi (SUCOMA). Essentially the DAR is responsible for research on all smallholder crops, plus all estate crops, with the exception of tea, tobacco and sugar which are supported by their respective industries. Bunda College provides leadership for *Phaseolus* bean research, with support from the DAR.

The agricultural research system in Malawi is relatively young with essentially all of its Malawian scientific staff being trained since independence in 1964. The historical roots of the system go back to the colonial period when primary emphasis was given to export crops, a pattern that continued during the late sixties when the research system continued to be directed and largely staffed by expatriate research personnel (see Table III-8. Since the early seventies, as trained Malawians began to replace expatriate scientists in both leadership and scientific positions, there has been a steady evolution of the research system into the one that exists today. Generally, the agricultural research system in Malawi is oriented toward applied and adaptive research aimed at technology development. The research system appears to be directly in support of the government's agricultural development goals and objectives. However, given recent disruptions in rail services to Mozambican ports, the government

appears to be rethinking its agricultural policy of increasing reliance or dependency on imported fertilizers and other imported inputs. Also, the rail constraint and concomitant high transport costs is giving added impetus toward diversification into high value crops. Many of these commodities require high management skills, and are beyond the capacity of most smallholders. Therefore, the research system is at a major decision point with respect to future research priorities.

A related issue is whether more research resources should be allocated to the staple food crops, so with increased productivity, smallholders can utilize more of their scarce land resource for cash crop production. Or whether Malawi should pursue the diversification strategy directly, by allocating more research resources to high value crops. This latter strategy appears to have some merit, given the current situation of food self-sufficiency in maize production and the growing food grain reserves. However, this issue must be considered in light of current levels of food crop productivity and how new technology may influence the structure of smallholder agriculture. The estates and some larger smallholders have more resources and higher management skills; also they do not have to devote the majority of their land resource to subsistence production. Therefore, they have greater capacity to utilize new technology that would result from a research strategy that emphasized diversification into high value commodities. This resource allocation issue is examined in considerable detail later in this chapter.

Another operating strategy of the research system, which is in the process of change, is to minimize farmer involvement in the technology

development process. This policy protects farmers from the potential risks of premature access to new technology that is not fully tested. However, it also reduces the opportunity for scientists to learn from farmers and to receive early feedback. This feedback can provide information about the potential usefulness and possible constraints of new technology until after it has completed a lengthy testing and approval process. Furthermore, the centralized approval process has resulted in "blanket" recommendations for the country as a whole, rather than localized, technical recommendations. The recent move to deploy adaptive research teams (ARTs) into each Agricultural Development District (ADD) is a direct step toward decentralizing the decision process, to develop more location specific technology and to more fully involve farmers in the research process.

Given this introduction to some central features and issues facing the research system, the structure of this chapter will be to (1) describe the constituent parts of the research system, (2) analyze the resources available to research and how they are being allocated, and (3) carry out a functional analysis of the system itself, including the use of system indicators that have been developed in this project. The following sections will provide a brief overview of the constituent parts of the agricultural research system.

Department of Agricultural Research (DAR)

Organization Prior to 1984:

The DAR, until early 1984, was organized through a system of three major and eight minor research stations. In addition, there were substations and district trial sites located in the different agroecological zones throughout the country. The location of these research stations and trial sites is shown on Map No. III-1 which follows.

The pattern of research organization that existed prior to 1984 was that each research station had an Officer in Charge (OIC) who directed and administered the research program at that station. Overall research direction and coordination was provided by the Chief Agricultural Research Officer (CARO), who was supported by an Assistant CARO and a Principal Agricultural Research Officer. Day to day research management and program implementation was the responsibility of the OIC of each station.

The program responsibility of each station was briefly described in ISNAR's Review of the Agricultural Research System of Malawi (1982, p. 11-13). These descriptions are presented here with minor editorial modification.

> Byumbwe Research Station, a main station located in the Shire highlands, was initially established to investigate the problems of tung production and to provide improved tung planting material. It is now primarily a horticultural research station. Its activities include a wide range of studies on soil fertility, moisture, and physical properties; variety and management trials on vegetables, fruit, tree nuts, maize, wheat, and cassava; plant protection; and crop storage.
>
> Chitedze Research Station, a main station near Lilongwe, does both crop and livestock research. The main programs include soil fertility and plant nutrition, farm machinery development, maize breeding and agronomy, groundnut breeding and management, wheat seed technology service, crop storage, pasture improvement, and livestock production.

Makoka Research Station, was a major station near Zomba and is almost entirely devoted to cotton research and cotton seed production. (although it is not located in a major cotton-growing region). Cotton research includes breeding for several specific objectives, and developing insect management, weed control, and agronomic practices. Its production research program seems comprehensive for its staff composition, but it lacks facilities for important fiber tests. It also accommodates the biometrics unit of the Department of Agricultural Research and the armyworm forecasting service.

Baka Research Station does research on maize varieties, spacing, and fertility; beans; groundnuts; burley tobacco; coffee, forage grass; and cassava; and performs a wide range of trials on cotton and rice. It is essentially a testing site for national trials.

Chitala Research Station is basically a substation for Chitedze. It was established in 1929 for cotton research. The present scope of work of the station covers variety evaluation, agronomy, and crop protection trials of maize, groundnuts, cowpeas, sunflowers, pigeon peas, cassava, beans, sorghum, cotton, tree fruit and tree nut crops; a fruit tree nursery; and livestock.

Kasinthula Research Station is mainly for research on irrigated crops (maize, rice, horticultural crops, and cotton), but it also has some crops under rainfed conditions. It functions as a testing station for national maize and cotton research. Water consumptive use studies on maize, wheat, beans, and cotton have been undertaken and are continuing. Many tests are being done on vegetables and bananas, including variety, fertility, and moisture requirements.

Lifuwu Research Station does irrigated and rainfed rice research including rice agronomy and breeding, and produces rice seed. There are some agronomic evaluation studies on mangoes and cashews.

Lunyangwa Research Station serves as the main station for root crops (cassava and sweet potato) research. Other research activities at the station include trials on coffee, and agronomic evaluation work on legumes, cotton, pastures, livestock, and macadamias.

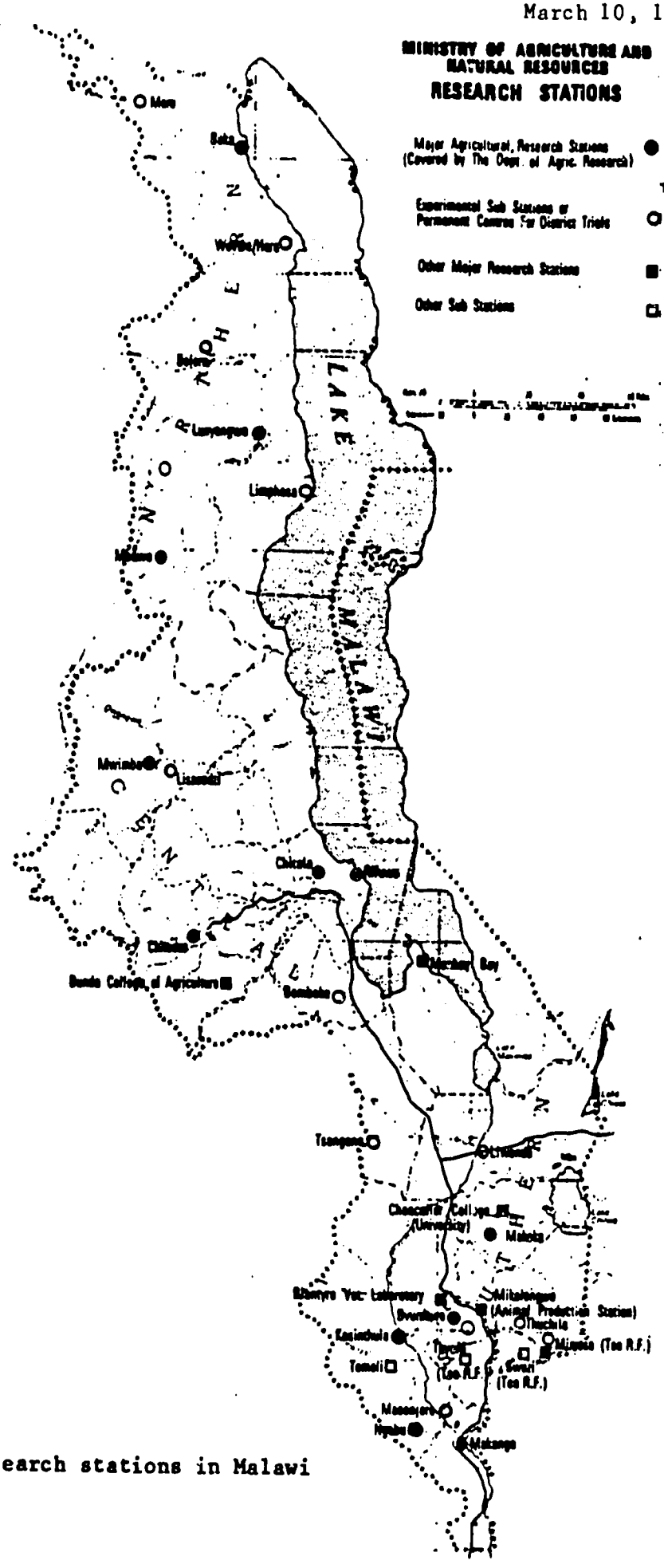
Mbawa Research Station was initially established as a stock farm and a livestock quarantine facility. The station's functions have gradually changed to studies of crop production requirements in the Mzimba area. The work includes mixed cropping; adaptation trials on maize, groundnuts, beans, sunflowers, and upland rice; and some tobacco, agroforestry, pasture improvement, wheat, and livestock research.

Makanga Research Station was developed for seed production and as the first cotton research station, but is now used for studies of rainfed and irrigated crops, particularly tree crops, maize, rice, groundnuts, cotton, and cocoa. The station pumps water from the nearby river for furrow and sprinkler irrigation. Periodic severe floods have affected the usefulness of the station.

Ngabu Research Station was a minor testing site but was upgraded in the early 1970s to investigate crop production requirements in the Ngabu Agricultural Development Division. It main activities are agronomy and variety trials of rainfed sorghum, millet, and guar. Maize, groundnuts, cowpeas, and cotton breeding and agronomy are also studied. A substantial on-farm verification trial program is run from Ngabu in cooperation with extension personnel.

In addition to the above 11 research stations, there were substations and district trial posts sited in different agroecological zones. Staff at several minor stations were also involved in on-farm trials in their respective areas.

The basic structure and staffing pattern for the DAR, as it existed before reorganization in early 1984, is presented in Figure III-1 which follows:



Map 1. Agricultural research stations in Malawi

Figure III-1: Structure and Staffing Profile of the Department of Agricultural Research prior to the Reorganization in 1984.

Chief Agricultural Research Officer P4

Asst. Chief Agri. Research Officer	F6
Principal Agri. Research Officer	P7
Executive Officer (Research)	EO
Research Liaison Officer	CTO
Accountant Research	Peace Corps
Economist Research	VSO

RESEARCH STATIONS

Staff	Chitedze	Bvumbwe	Makoka	Kasinthula	Lifuwu	Lunyangwa	Makanka	Chitala	Mbawa	Ngabu	Baka
Officer in Charge	P7	P7	P6	PO	P8	TO	STA	TO	TO	TO	STO
PO	48	17	12	2	2	0	0	0	0	3	0
TO	31	28	9	3	3	5	0	2	2	2	4
TA	72	50	24	10	6	10	10	12	10	17	14
Sub-Stations	3	1		1	1	2	1			3	5

Under this structure, the Officer-in-Charge (OIC) of each research station provided overall scientific direction for research programs conducted at that station, as well as having administrative responsibility and control for all station activities. This research structure gave considerable autonomy to the OIC, but reduced opportunities for national level program coordination and direction. Therefore, starting in 1982 with a major study of the research system, which was conducted by ISNAR, followed by a continuing process of internal review within the Ministry of Agriculture, interspersed with external project design teams from the World Bank and USAID, a plan emerged for a major reorganization of the DAR.

Emerging Organization Since 1984:

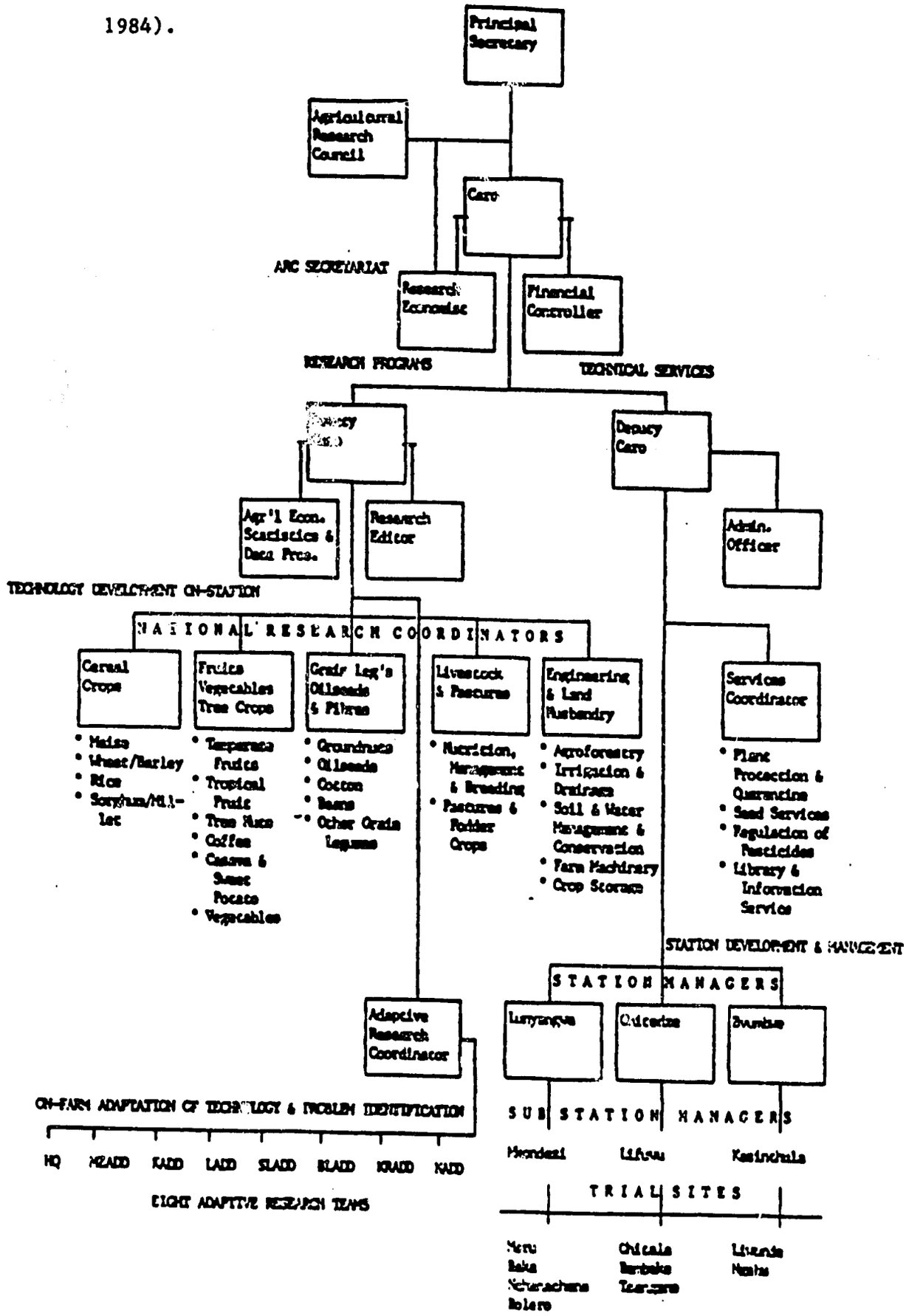
The DAR began this major reorganization in January 1984 and by August, 1985 (when data collection for the case study was undertaken), the new administrative structure was essentially in place (see Figure III-2). However, the associated development of the physical facilities and related staff development activities for the new research organization will effectively begin in 1986 with the initiation of World Bank and USAID financed projects. These new projects, which will be implemented over the next five years, will result in a major up-grading of both the human and physical resources for agricultural research and these projects will be in direct support of the new research structure.

Under the new structure, the Department of Agricultural Research of the MOA continues to be headed by the Chief Agricultural Research Officer, but is now assisted by two Deputy Chief Agricultural Research Officers: one for Research Coordination and the other for Technical Services. As

indicated on the DAR organization chart (Figure III-2), research programs are directed toward the specific technology needs of smallholder farmers in food and cash crops research (with the exception of tea, tobacco, and sugar), including horticulture and livestock research. In addition, a new adaptive research program has been established aimed at integrating the technology from commodity research programs to fit the specific needs of farmers in each agro-ecological zone of Malawi. The DAR also provides technical services such as: seed multiplication and certification; information about soil and water conservation, and disease and pest control; and diagnostic expertise. (Devres, p.)

The newly formed Agricultural Research Council (ARC) is expected to function as the research policy advisory board for the DAR. The Agricultural Research Council includes the Controller of Agricultural Services as Chairman, the CARO, the Chief Agricultural Officer (CAO), the Chief Veterinary Officer, the Chief Forestry Officer, Secretary of the Malawi National Research Council, representatives of the University of Malawi, the Tea Research Foundation, Tobacco Research Authority, the Sugar Plantations, the Estates Advisory Board, and the Economic Planning Division. Policy responsibilities of the ARC include, (1) ensuring that the agricultural research strategy is consistent with available resources, (2) confirms that national research goals are consistent with national agricultural development goals (3) provides guidance in the development of an agricultural research master plan (4) reviews the DAR's annual research program, (5) advises on donor assistance, and (6) insures that contract research is oriented to the needs of the country.

Figure III-2: Department of Agricultural Research (as reorganized in 1984).



Under the reorganized system, the technology development function is to be largely carried out through national Commodity Research Teams (CRT's) that are largely carried out through on-station research led by a commodity research program leader. As shown in Figure III-2, these commodity research programs are grouped under 4 major research areas, including: (1) cereal crops, (2) fruits, vegetables and tree crops, (3) grain legumes, oil seeds and fibers and (4) livestock and pastures. These 4 major program areas are led and coordinated by national research coordinators (NRC's), who report directly to the Deputy Chief Agricultural Research Officer for program and research coordination. In addition, there are also national research coordinators for (5) adaptive research, (6) engineering and land husbandry and (7) technical services.

The Commodity Research Teams operate nationally, working principally within the research station network and associated trial sites. The national commodity teams are structured to develop general recommendations applicable to the major agro-ecological zones of Malawi. Their research is focused on varietal improvement, plant protection and related cultural practices. National commodity research is to be conducted under experiment station conditions, with optimum levels of management. The CRT's have the responsibility for updating the basic recommendation transmitted by the extension service particularly through the Annual Agricultural Production Handbook of Malawi.

Eight Adaptive Research Teams (ART's) are planned, one each for the eight Agricultural Development Districts (ADD's). Four are currently organized: Blantyre, Lilongwe, Liwonde and Kasungu. The work of the ART's

is coordinated by a National ART Coordinator reporting to the Deputy CARO for research programs. Each ART is to be composed of an agronomist and a socio-economist from the DAR and an extension specialist from the ADD. The ART operates from the headquarters of the ADD. The function of the ART is to generate locality-specific production recommendations to be used by the ADD extension service. The ART is to identify common farmer problems which appear amendable to common solutions. Adaptive Research Teams are to: (1) identify key problems of farmers, (2) search for recommendations that will apply to farmers problems, and (3) develop and test recommendations tailored to local agronomic, social and economic conditions.

One of two Deputy CARO's is in charge of <u>technical services and administration</u>. The management of the three main experiment stations, (which under the reorganized DAR system will be located at Lunyangwa, for the Northern Region, Chitedze for the Central plateau and Bvumbwe for the South) with their satellite substations and trial sites is vested in station administrators who report directly to the Deputy CARO-administration and services. Their responsibilities include: (1) administration of the common services of the station including library facilities, maintenance of grounds, buildings, and utilities, (2) labor resource allocation, including supervision of the farm manager, (3) allocation of transport, and (4) preparation of the technical services annual budget. Each station's technical services administrator is to be assisted by a station advisory committee composed of the senior research scientists at that station. The advisory committee is chaired by the most senior researcher.

Soil and plant analyses, soil survey, crop protection, plant quarantine, seed certification, and the library and information services are directed by a National Technical Services Coordinator who reports to the Deputy CARO for administration and technical services. The technical services teams are directed by a Service Team Leader who reports to the National Technical Services Coordinator who is located at the Chitedze Agricultural Research Station.

Because research programs are now being organized and directed by national research coordinators and commodity research leaders (CRL), the function of the Officer-in-Charge (OIC) of research stations has been changed to a managerial and administrative role. A senior scientist, who also has on-going research responsibilities, is assigned the role of station manager. The manager is assisted with day-to-day administrative duties by an Executive Officer. Each station has an overhead budget to cover general operating expenses and maintenance of the station. Each research program in turn has its own separate research budget to cover program specific expenses.

Annual Research-Extension Workshops are planned at both the ADD and national level. At the ADD level, these workshops draw upon the national commodity research team and serve to make these research specialists more cognizant of field problems. The ADD Research-Extension Workshops, in addition to focusing on ADD level problems, are expected to strengthen the link between CRT's, ART's and ADD extension subject matter specialists. These contacts are the focal point for familiarizing research staff (particularly the CRT's) with the problem of farmers.

Each ADD conducts an annual review meeting after the growing season when the data has been analyzed (usually in July). At this annual meeting, research and extension personnel finalize the substance of the ADD report for presentation at the annual National Research-Extension Workshop. In the process of reviewing these research findings, extension messages are to be modified and updated for local site-specific needs.

Each CRT is also responsible for providing leadership for a crop-specific national commodity workshop to be held each year. These workshops are convened by the National Research Coordinators. Results of the past year's research, which have been conducted by the Commodity Research Teams are to be reviewed. This annual report also includes proposed research plans for the next fiscal year and the budget needed to implement this proposed research program. Therefore, scientists request funds a little more than one year in advance of when the research will be initiated.

The final step in the planning-review process is the National Research-Extension Workshop which is to be conducted annually (in early October) by the Agricultural Research Council. Its purpose is to plan overall research strategy, review research-extension linkages, and agree on aspects of the research system and its program that need improvement. The following areas may be reviewed: (1) effectiveness of ADD workshops, (2) adequacy of commodity recommendations in extension publications, (3) commodity research program priorities, (4) operation and organization of the Adaptive Research Team (ART's), and (5) the relevance of DAR's applied research program to ADD problems. The annual reports of the ADD's and the

Commodity Research Teams (CRT's) are the major background papers for this meeting.

Specific details of resource allocation, organization, and research output of the DAR will be covered in the analytical section of this chapter. The purpose here is to give the reader a brief overview of the component parts of the research system itself. Therefore, the other parts of the agricultural research systems will be described next.

Department of Veterinary Services

The Department of Veterinary Services (DVS), which is part of the Ministry of Agriculture, has responsibility for veterinary and related livestock disease research under the overall direction of the Chief Veterinary Officer. Research is primarily done at the central laboratories at Lilongwe, with supporting laboratories at Blantyre and Mzuzu. The research program largely involves three projects: the East Coast Fever Project, the African Swine Fever Project and the Newcastle Disease Vaccine V4 project. (Devres, p. xxiii-xxiv). It was estimated that in 1983 there were about 9.5 full-time equivalents of professional staff involved in veterinary research (Devres, p. 42).

Bunda College of Agriculture

The Bunda College of Agriculture of the University of Malawi was founded in 1965 and currently conducts research programs in each of the four departments of the College: Crop Production, Agricultural Engineering, Livestock Production and Rural Development. One of the more significant research projects is the *Phaseolus* bean research program. Bunda College provides national research leadership for the bean research

program under the direction of the NRC for grain legumes, and maintains a world-wide germplasm collection. It also carries on crop improvement studies in other grain legumes (cowpeas, groundnuts and pigeon peas), maize and pastures. The livestock production department conducts nutrition studies for swine and small ruminants; the rural development department does studies on the diffusion and impact of new technology on farming systems and rural communities in Malawi; and agricultural engineering does studies on grain drying and storage, and soil erosion. It is estimated that about 6 full-time equivalent faculty are involved in research at Bunda College (Devres, p. 44).

Tobacco Research Authority

Historically, research to support tobacco production in Malawi was strongly linked to the Tobacco Research Authority of Southern Rhodesia (now Zimbabwe). Since tobacco is very important to the agricultural economy of Malawi, in 1980 the Malawi Government created the Tobacco Research Authority to directly serve the research needs of the industry. Although the Malawi TRA maintains contact with the Zimbabwe TRA, Malawi no longer contributes financially to this quasi-regional research organization.

The newly created Malawi TRA is largely industry financed through a levy of 0.7 tambala/kilogram (about one-half U.S. cent in 1985) that is charged for all tobacco sold over the auction floors in Malawi. In addition the Food and Agriculture Organization of the United Nations (FAO) is contributing technical assistance (through 1986) to the TRA by providing expatriate staff.

The TRA has two research stations: Kandiya, which is located outside of Lilongwe and serves as the headquarters for the TRA and which focuses on burley and fire-cured tobacco research; and Mwimba, which is located near Kasungu and concentrates on flue-cured and oriental tobacco research. In 1985, the TRA had a professional staff of 12 research officers, including 2 expatriates.

Tea Research Foundation

The Tea Research Foundation (TRF) of Central Africa is located in Malawi and provides research services for the tea industry in Malawi, Zimbabwe and South Africa. It conducts research on all aspects of tea production and processing. Since tea is primarily an estate crop in Malawi, the research program is largely industry financed. In addition, the TRF maintains close relations and receives financial support from the following organizations: Tea Association of Central Africa, the Zimbabwe Tea Growers Association, the Transkei Tea Development Cooperative and SAPEKO, a group of private tea companies in South Africa (Devres, p. 44, 46).

The TRF has two research stations (Mulanje, which is the headquarters for the TRF and at Thyolo) and two substations (Mimosa and Nsuwadzi). In 1984, the TRF had a research staff of 13 scientists, of which 7 were expatriates (Devres, p.47). The TRF has limited research facilities, but enjoys a high scientific reputation (ISNAR, p. 18).

Sugar Research

The Sugar Corporation of Malawi (SUCOMA) provides resources for a small research program which is operated at the Nchalo Sugar Estate. This

modest research program was started in 1968 and largely focuses on the introduction and testing of new, improved genetic material. A close linkage is maintained with the Mount Edgecombe Sugar Research Station in Natal and one pathologist/agronomist operates the research program, assisted by three technical officers and seven support staff.

Resources Available for Agricultural Research

National Financial Resources

A country's ability to develop and/or borrow new agricultural technology is dependent on having sufficient national research capacity to initiate and then maintain a flow of new technology to farmers. Therefore, building national research capacity should be viewed as a national investment that can increase the productivity of the agricultural sector in the future. An "adequate" level of national research investment will vary from country to country, depending in part on its policy objectives, the size of the country, number and type of different agroecological areas to be served and the potential to borrow technology from neighboring countries and/or the international system. A general rule of thumb for investment in agricultural research is 1% of agricultural gross domestic product (AGDP).

In Table III-1 the total national and private agricultural research investments for Malawi for 1984 are listed by institution. As shown in this table, the total national agricultural research investment in 1984 was about MK 5,138,990. As shown in Exhibit III-1, at the end of this chapter, the total value of agricultural production in Malawi in 1984, adjusted to current prices was found to be about US$ 711.4 million. Therefore, national and private investments in agricultural research amounted to about

0.72% of AGDP. This level of research investment is less that the recommended level of 1% of AGDP, but it is considerably higher than most African nations. However, while overall research expenditures are increasing in real terms (see section on growth in research expenditures) given growth in the agricultural sector, very little progress is being made to increase this overall index of research investment.

Table III-1: National and Private Agricultural Research Expenditures by Institution (1984)*

Institution	Headquarters	Funding Source	Funding Amount MK
1. Dept. of Agric. Research	Lilongwe	GOM	3,331,690.
2. Dept. of Vet. Services	Lilongwe	GOM	185,000.
3. Tobacco Research Authority	Lilongwe	Tobacco Assn. of Malawi	658,000.
4. Tea Research Foundation	Mulawje	TRF of Central Africa	750.000.
5. Bunda College of Agriculture	Lilongwe	Univ. of Malawi	66,300.
6. Sugar Corp. of Malawi (SUCOMA)	Blantyre	Lonrho Ltd.	148,000.
Total			MK 5,138,990.
		Equivalent to	US$ 3,953,069.

Table adapted from Table 5 in D.R.B. Manda, et. al., Agricultural Research Assessment in SADCC Countries, Volume II: Malawi, published by DEVRES, Inc., 1985, p.27-28.

Allocations to Commodity Research

Another indicator of research investment is the allocation of research resources to different commodity programs. In general, it is expected that a nation will invest more in those commodities that are relatively more important to the national economy. Table III-2 provides an overview of the relative contribution of different commodities to the AGDP (6 year average) contrasted with the relative level of research expenditure in each commodity programs.

Some notable research investment patterns can be found in Table (III-2). First, maize and roots/tubers (cassava and sweet potato), which are the primary staple foods of Malawians appear to be receiving a relatively low share of research resources. Also, tobacco and groundnuts, which are two very important export crops for Malawi and which are also important cash crops for smallholders are also receiving less than average resources. Agroforestry research, which is crucial to the provision of firewood for tobacco curing and household use also appears to be receiving relatively few resources.

Since the Tea Research Foundation serves Southern Africa and receives funds from cooperating organizations outside of Malawi, it was not surprising to see a relatively high level of investment in this crop. Sugar research (supported by private funds), plus wheat, coffee and cotton research appear to be supported at levels above their relative contribution to the agricultural economy. The relative over or under investment for other commodities is shown in Table III-2, as reflected in the index of research investment. Index numbers for the minor commodities must be

interpreted with caution. The purpose of this table is to show general relationships between research investment patterns and the relative economic value of the commodity.

Table III-2: Relative contribution of Commodities to AGDP and Relative Level of Research Investment in Different Agricultural Commodities

Commodity	Contribution to AGDP (%)*	Level of Research Investment (%)**	Index of Research Investment ***
1. Maize	21.4	7.1	0.3
2. Rice	1.1	3.0	2.7
3. Millet, Sorghum & Wheat	0.5	3.3	6.6
4. Roots & Tubers	8.2	2.7	0.3
5. Groundnuts	8.1	5.7	0.7
6. Pulses & Oilseeds	1.2	3.3	2.8
7. Cotton	1.9	6.0	3.2
8. Tobacco	22.4	17.9	0.8
9. Tea	8.9	20.4	2.3
10. Coffee	0.5	3.3	6.6
11. Sugar	0.9	4.0	4.4
12. Fruits & Vegetables	12.8	10.6	0.8
13. Livestock	9.3	11.6	1.2
14. Firewood	2.7	1.1	0.4
15. Fish	0.1	n.a.	--
Total	100.0%	100.0%	

* Based on 6 year average (1980-85), see Exhibit III-1

** Based on 1984 Expenditures and includes only Commodity Research Expenditures.

*** Computed by dividing level of research investment by the relative contribution of the commodity to the AGDP. An index number of less than 1 indicates a relatively low level of investment and vice versa.

Resource Level for Program Support

In some countries, personnel costs tend to increase faster than the total recurrent budget, thus cutting into resources for program support. In these situations, researchers may be on-the-job, but have no resources for operating a research program, including such things as supplies, transportation and/or field workers. Therefore, another indicator of the adequacy of financial resources is the proportion of program and operating funds to the overall recurrent budget.

In the case of the DAR, (five-year average, 1981-85) an analysis of research expenditures found the following allocation:

Salaries/personal emoluments	50.5%
Program & Operating expenses	43.3%
Capital expenditures (maintenance and small equipment)	6.2%
	100.0%

Comparable data was also computed for the TRA, however, since it is still strengthening its physical facilities, its capital budget is still relatively large. Therefore, when excluding capital expenditures, the proportion of the recurrent budget (5 year average) devoted to personal emoluments and program costs was found to be 44.2% and 55.8% respectively. Comparable data were not available for the other agricultural research institutions.

Growth in Research Expenditures

A final measure of the financial resources available to agricultural research is the actual and real growth in agricultural research expenditures over time. Data on agricultural research expenditures was

only available from the DAR and the Tobacco Research Authority. These findings are presented in Table III-3 and Table III-4, respectively.

Table III-3: Annual Research Expenditures for the Department of Agricultural Research, (in current Kwacha and deflated Kwacha, using 1878 as the base year).

Fiscal Year	Annual Expenditures Incurrent Kwacha	Deflated Expenditures (using 1978 as base)	Annual % Change in real terms
1975-76	843,179		
1976-77	1,012,675		
1977-78	1,081,469		
1978-79	1,365,568	1,365,568	
1979-80	1,657,183	1,512,028	+10.7%
1980-81	1,876,002	1,438,362	-04.9%
1981-82	2,205,679	1,534,919	+06.7%
1982-83	3,220,136	2,017,629	+31.4%
1983-84	3,224,841	1,758,365	-12.6%
1984-85	3,486,720	1,786,230	+01.6%
1986 (estimated)	3,952,175	n.a.	

As can be seen from Table III-3, DAR research expenditures (in current Kwachas) have risen steadily over the past decade, averaging about a 26% annual increase each year. When these expenditure levels are deflated to 1978 prices, to account for inflation, research expenditures have increased on the average about 5% per year in real terms, but with sizeable increases and decreases during this period.

Table III-4: Growth in Research Expenditures for the Tobacco Research Authority

Year	Current Expenditures	Deflated Expenditures (using 1978 as base)	Annual % Change in Real Terms
1980	396,633	361,891	
1981	538,827	413,211	+14.2%
1982	635,388	442,163	+07.0%
1983	600,792	376,436	-14.9%
1984	655,755	357,555	-05.0%

The TRA's expenditure level was nearly the same in 1984 (in real terms), as it was in the first year of operation. After modest gains during the second and third year of operation, the TRA's expenditure level fell an equivalent amount the following two years (in real terms). These data reflect the first 5 years of operations, a period of needed physical facility capital expansion, as well as the expansion and up-grading of the research staff. These data (along with those presented earlier in Table III-2) show that tobacco research is receiving relatively fewer research resources than other commodities and that the situation is becoming worse in real terms. This relatively low level of investment is occurring during a period of substantially increased earnings from tobacco as Malawi's chief export crop (tobacco represents about 22% of the value of AGDP). In fact, it is estimated that tobacco research only received 0.33% of the value of tobacco earnings in 1984.

Financial Resources from Donors

Most donor support involves capital investments in facilities and equipment, technical assistance (expatriate technical support) and training (human capital development). These project resources generally came through the "development account" to one or more of the agricultural

research institutions for specific purposes. The type and level of donor support for agricultural research is summarized in Exhibit III-2 for 1984. Starting in 1986, donor assistance to the DAR will increase sharply, given the approval of the World Bank loan for the national agricultural research project and the USAID grant for the agricultural research and extension project.

Human Resources

The most important resource affecting national research capacity is the scientific and technical personnel that make up the national research system. While research officers are hired with only a B.Sc. degree, the M.Sc. degree is the first "research" degree, and it is generally considered the minimum qualification for a "trained" scientist. It takes, on average, about 18 years of formal education for an individual to obtain the M.Sc. degree and 20-22 years for the Ph.D. degree. Therefore, the human resources needed for a national research system take considerable time to develop and are frequently the scarce resource that can constrain a country's access to new technology. Furthermore, since the overall supply of trained agricultural personnel in Malawi (and in Africa as a whole) is small, there is considerable demand (both in Malawi and internationally) for agricultural researchers with post-graduate training.

An overview of the number of agricultural research personnel in Malawi during 1984 is presented in Tables III-5 and III-6. These data include both national and expatriate personnel. Overall, there were about 161 national and 38 expatriate professional level agricultural research personnel (including research administrators) in Malawi at that time.

Table III-5: Number of National Agricultural Research Personnel in Malawi in 1984 by Institution and Type of Position.

	Number of National Research Personnel				
Institution	Professional	Administrative	Technical	Support Staff	Total
Dept. of Agr. Research	79	13	88	340	520
Dept. of Vet. Services	22[a]	3	7	46	78
Tobacco Res. Authority	11	4	7	48	70
Tea Research Foundation	21	2	5	28	56
Bunda College of Agr.	43[b]	-	10	190	243
Sugar Corp of Malawi (SUCOMA)	1	-	3	7	11
TOTAL	177	22	120	659	978

[a]In terms of research, this number is equivalent to only 9.5 full time person years.
[b]In terms of research, this number is equivalent to only 5.8 full time person years.

Source: Adapted from Manda, D.R.B., et. al. (1985). Agriculture Research Resource Assessment in SADCC Countries, Volume II: Malawi, pp. 27-28

Table III-6: Total National and Expatriate Agricultural Research Staff in 1984.

	Administrative	Professional[a]	Technical[b]	Support Staff	Total
Total Authorized Posts	18	184	158	869	1229
Positions Vacant	1	37	38	210	286
Nationals (Citizens)					
Staff in Training	-	39	8	1	48
Staff on long-term leave[c]	-	1	-	-	1
Number of nat'ls currently in posts	14 78%	147 80%	120 76%	659 76%	943 77%
Expatriates					
Serving in authorized posts[d]	3	15	-	-	18
Expressed as percent of authorized posts	17%	8%	-	-	1%
Not in authorized posts	5	15	-	-	20
Total number of expatriates	8	30	-	-	38
Total Number of Staff	22	177	120	659	978

[a]Professional = BSc or above.
[b]Technical = diploma holder.
[c]Long-term leave is leave of three months or more.
[d]Irrespective of source funding.

Source: Manda, D.R.B., et. al. (1985). Agricultural Research Resource Assessment in SADCC Countries, Volume II: Malawi, 1985, p.52.

Another measure of research investment is the number of agricultural scientists/U.S. million dollars of AGDP. On average in Africa, about 1% of AGDP invested in agricultural research will result in about 0.39 scientists/US$ million of AGDP. In the case of Malawi, in 1984 it was found that there were 0.23 national scientists or 0.28 total scientists (including expatriates)/US$ million of AGDP (at current prices). This number of scientists appears to be about two-thirds of the number of scientists needed if Malawi were to have a fully staffed research system at the 1% of AGDP research investment level.

In addition, as shown in Exhibit III-5, the quality of research personnel, in terms of educational qualifications, appears to be below the desired level of nearly all research officers having a minimum of an M.Sc. degree (i.e. the first level research degree). In 1984, it was found that of the national research staff, only about 45% had post-graduate qualifications (M.Sc. or Ph.D. degrees), while the rest only had B.Sc. degrees. These data suggest that more than half of the current research staff need research training at the post-graduate level.

The number of research scientists by commodity program and educational level is presented in Exhibit III-3. These data have been aggregated in Table III-7, which follows, to compare the percentage of national research effort as measured by the number of FTE assigned to each commodity research program, with the contribution of each commodity to the agricultural economy.

Table III-7: Index of Research Investment based upon the percent of national research personnel assigned to each Commodity Research Program compared with the Economic Contribution of the Commodity to AGDP.

Commodity	Percent Contribution to AGDP (6 yr.ave.)	Percent of National Research Personnel*	Index of Research Investment
Maize	21.4	7.4	0.3
Rice	1.1	2.6	2.4
Millet, Sorghum, Wheat	0.5	6.5	13.0
Roots & Tubers	8.2	2.0	0.2
Groundnuts	8.1	11.1	1.4
Other Pulses/oilseeds	1.2	2.5	2.1
Cotton	1.9	9.7	5.1
Tobacco	22.4	14.2	0.6
Tea	8.9	12.7	1.4
Coffee	0.5	1.2	2.4
Sugar	0.9	1.2	1.3
Fruits, Vegetables, Nuts	12.8	8.8	0.7
Livestock	9.3	20.1	2.2
Firewood/timber	2.7	0	0
Fish	0.1	0.0	--
	100.0%	100.0%	

*Note: Non-commodity research personnel (35.5% of total research personnel) have been excluded from these calculations. Percent of research effort includes only professional level staff.

As shown in Table III-7, based on each commodity's contribution to AGDP, agroforestry, roots and tubers, maize, tobacco and horticultural crops appear to be receiving below average allocations of professional level research personnel. Wheat and cotton are two commodity research programs that appear to be receiving a proportionately larger share of research scientists. These findings are quite similar to the relative allocation of financial resources to different commodity research programs.

Another perspective on the human resource dimension is the agricultural research system is its relative growth over time. Data on the number of research personnel over time is only available for the Department of Agricultural Research and these data are presented in Table III-8. At independence, there were only two trained Malawian research officer in the DAR, while only two decades later there were about 90 professional-level, national research officers and administrators. Over the past decade, this amounts to about a 15% annual increase in the number of professional level national research personnel; since 1980, this rate of increase has fallen to about a 5% annual increase.

A final indicator of the human resources available to a national research system are the number of research technicians available to support the scientific staff. This indicator is expressed in terms of a ratio; the generally recommended level would be 2 technicians for every scientist, or a 2:1 ratio. According to the data represented in Table III-8 in 1984 there were 120 technical officers (with 3 year diploma level training) for 177 professional level research officers, or a 0:67 ratio for the entire research system. However in Malawi, much of the technical support work is

carried out by the technical assistants, who have 2 year certificate level training. Therefore, it was estimated that there was about a 2.5:1 research technician-scientist ratio for the DAR and TRA in 1984 when including both technical assistants and technical officers.

Table III-8 :Number of Research Personnel in the Department of Agricultural Research from 1964 - 1985

Year	Superscale		Professional Officers		Technical Officers		Technical Assistants	Total
	E	M	E	M	E	M		
1964/65	4	0	17	2	13	11	124	169
1965/66	4	0	14	5	10	14	77	122
1966/67	4	0	15	6	10	14	82	131
1967/68	4	0	15	6	11	16	82	134
1968/69	4	1	18	9	5	19	119	175
1969/70	3	2	18	9	1	24	119	176
1970/71	7	2	17	9	1	29	120	185
1971/72	7	3	17	11	0	30	120	188
1972/73	6	4	14	14	0	38	124	200
1973/74	5	5	2	18	1	37	124	199
1974/75	2	8	11	27	1	37	126	200
1975/76	2	8	8	34	1	47	134	220
1976/77	2	13	7	36	0	55	191	304
1977/78	1	17	6	41	0	73	202	340
1978/79	1	22	5	48	0	84	202	360
1979/80	0	22	1	50	0	84	204	361
1980/81	1	22	2	50	0	85	206	366
1981/82	n.a.	24	n.a.	51	n.a.	93	229	397
1982/83	"	24	"	54	"	95	222	395
1983/84	"	32	"	51	"	94	255	432
1984/85	"	34	"	55	"	85	229	403
1985/86	"	32	"	55	"	88	245	420

Source: Adapted from ISNAR (1982), p. 20 and up-dated from 1981 with the number of established positions outlined in the Approved Estimates of Expenditures on Revenue Account, for fiscal years 1981/82 through 1985/86.
E = Expatriate
M = Malawian

Functional Analysis of the Research System

Major Research Functions and How they are Organized

As noted earlier, the DAR underwent a major reorganization, beginning in 1984. Therefore, the DAR is moving from a research system, where research station directors (OICs) had considerable administrative and scientific control over research programs and personnel, to a more centrally directed research system, which was just beginning to function at the time of data collection. Under the emerging system, the allocation of research resources will be given policy direction by the Agricultural Research Council with details being worked out by the CARO, the Deputy CARO for programs and the National Research Coordinators (NRCs). Specific Research Program direction and coordination will be largely in the hands of the Commodity Research Team leaders (CRT), and the Adaptive Research Team (ART) leaders, with overall guidance and review by the NRCs. Both the previous and emerging systems will be described and discussed briefly.

Under the previous system, individual commodity research programs were the primary responsibility of one research station (see the station descriptions at the beginning of this chapter), although district trials were handled by other research stations for their respective agro-ecological area. The primary focus of each commodity research program was on varietal improvement, plan protection and developing appropriate cultural practices. In addition, however, the commodity research program also had responsibility for the adaptive research functions for their particular commodity. This adaptive research function, including verification trials, that were carried out on research stations,

substations, regular trials sites as well as on farmers' fields. For example, until 1984, the maize program had 103 district trials per year, at locations throughout the country, on all aspects of maize improvement. In discussions with several CTRs, there was demonstrated commitment to field research, including on-farm research, with the objective of developing, testing and adapting commodity specific recommendations.

Although the commodity research programs were conducting district trials throughout the country, which provided a potential data base for location specific recommendations, the technology approval process only resulted in generalized recommendations for the country as a whole (note: this issue is discussed at greater length in the chapter on "Flow through the System"). Furthermore, since extension subject matter specialists (SMS) in each ADD had no access to the research findings from these district trials carried out in their respective ADDs, they were generally unable to specify how generalized recommendations might be modified to better fit the needs of farmers in their respective area.

Another constraint in the previous research organization was that it had no capacity to systematically assess farmer resources, limiting factors and possible technology needs. Furthermore, it was left to the farmer to integrate research findings and recommendations for each commodity research program, rather then research working with farmers in this process. Therefore, starting experimentally in 1982, which was subsequently regularized as the adaptive research program in 1984, was a new research activity which could help address these specific research needs. The

functional responsibility of the adaptive research teams (ART) and their relationship with the CTRs will be discussed next.

Under the new system, the basic responsibility of technology development and assessment rests with the CRTs. This research work is to be carried out under the optimal conditions of the research stations, with limited testing on research substations and at a few research trials sites on government land. Generalized commodity recommendations will be developed from this testing and assessment work, and these recommendations will be forwarded to either the Varietal Release Committee (VRC) or the Technical Recommendations Committee (RC) for approval. In addition, research findings from these trials are to be shared with the ARTs, both informally during the year at the annual workshops.

The ARTs have been given full responsibility for the adaptive research function. In carrying out this research assignment, they are expected to systematically analyze and consider farmer resources, production systems and practices, and constraints in designing and analyzing adaptive research trials. Furthermore, they are expected to take the generalized recommendations coming from the different CRTs, plus any trial data that may have been generated in their respective ADD, while designing on-farm adaptive research trials that can generate location specific recommendations for farmers in their ADD. In practice, however, only the ART in the Liwonde ADD appeared to be functioning in this manner during mid-1985.

In reviewing two years of adaptive research findings at another ADD, and based on in-depth discussions with several CRTs, the integration of the

technology development, assessment and adaptive research functions, has yet to be achieved in most ADDs under the new organization. For example, much of the research being carried out by one ART, were research reports were available for two years, appeared to be largely duplicating commodity research. For example, it was conducting several experiments on the effect of stock lodging on maize yields, rather than modifying and fine-tuning maize production recommendations to meet the needs of farmers in that ADD. Furthermore, the quality of research conducted by this ART was so poor that the results for the majority of trials could not be used even if the design had been correct.

It appeared that many of these problems could be attributed to the lack of formal research training, since 10 out of 13 ART research officers have only BSc. degrees. In addition, most lack on-farm research and production skills. Under the forthcoming USAID funded agricultural research and extension project, there are a number of staff development plans to up-grade the research skills of each ART. It seems reasonable to expect that with formal research training, additional in-service research training provided by IARCs, plus additional on-the-job experience most ARTs should be fully functional by the early 1990's.

One notable exception to this situation was the ART in the Liwonde ADD. This ART has received considerable technical assistance and is already carrying out the adaptive research functions with considerable skill and insight. This ART is actually administratively attached to extension in the ADD, rather than to the NRC for ARTs in the DAR. While some observers felt that the success of this ART could be attributed to

this structural arrangement, it appeared that a more likely explanation was the high quality technical assistance that this ART had received, on a full time basis, since the inception of its research activities. This ART could be used both as a model for implementing the adaptive research function as well as an in-service training site for other ARTs.

Another issue about the ARTs that merits discussion concerns the number and deployment of both professional and technical support staff that are needed in each ADD. According to the proposed 1985-86 DAR budget, including staff allocations (see Exhibit III-6), there were to be 13 research officers (3 MSc., 10 BSc.) assigned to adaptive research supported by one technical officer (diploma level) and 7 technical assistants (certificate level) or a 0.6:1 technician to scientist ratio. While the ARTs were not fully staffed at the time of data collection, clearly without substantial increases in the number of support staff, the amount of on-farm adaptive research that can be accomplished will be severely constrained.

One possible solution to this problem is to make extensive use of SMS and field assistants to help carry out the on-farm trials. This solution implies, however, that extension personnel have sufficient time during the growing season for these additions tasks and that they have the necessary research skills. Given the problems of research quality mentioned earlier in this section, this possible solution appears limited.

There is also the added problem of very poor transport capability during the rainy (growing) season. For example in the Mzuzu ADD, the district headquarters, where the ART will be officed, is located on the Eastern edge of the district with very little paved road in the district.

During the growing (rainy) season, access to research trials in farmers' fields will become difficult, time consuming and costly. Vehicle delays due to impossible roads and high repair bills result in high transport costs and unreliable service. It is difficult to imagine how an ART team could cover this ADD without having four or five technical support staff, strategically located throughout the district to regularly monitor and carry out treatments on the field trials. This alternative implies that more technical assistants will be needed and they must be sufficiently trained to carry out most field research tasks with minimal direction and supervision.

The restructuring of the adaptive research function, by shifting responsibility for this task from the CRTs to the newly ARTs, is generally considered a positive development within the research system. The ARTs are to give systematic attention to farmer resources, constraints and technology needs, while monitoring, assessing and integrating the outputs of the CRTs into the adaptive research program for each ADD. In addition, each ART is expected to feedback information on farmer problems and priorities to the CRTs. However, over the next few years, there will be some moderately serious transition problems which need careful attention and resources.

While the long-term benefits of this reorganization appear to outweigh the short-term costs, attention must also be given to the technology approval process, so that these benefits can be realized. In particular, the CRTs, through their extensive number of district trials, were conducting more "adaptive research" in 1983 than will be conducted for some

time in the future by the ARTs. However, because this information was not shared with the SMS in the ADDs and because of the centralized approval process, only generalized technical recommendations emerged from the research system. The potential value of district trials, with respect to developing location specific recommendation for each major agro-ecological zone in the country, was never realized under the previous arrangement.

The decision to discontinue most of the CRTs district trials appears to be valid since these data were not used in developing location-specific recommendation anyway. However, unless the path by which technology is approved and made available to farmers is changed, the potential value of the ARTs may also be similarly constrained. This situation seems less likely to happen, since the ARTs are assigned to the ADD headquarters. Since extension needs this relevant information so badly, it is likely that even if the formal system is not changed, an informal system will soon develop whereby new information can flow directly out through the extension system.

In fact, the most serious gap in the emerging research system appears to be between the CRTs and the ARTs themselves. On the other hand, this may be largely a transition problem until both groups become comfortable with their new and redefined research roles. Given this overview of research functions in the DAR, a more in depth analysis of specific commodity research programs follows in the next section.

Indicators of Specific Functions, Linkages and Outputs of the Research System by Selected Commodities

The next section provides an analysis of the performance of the Malawian agricultural research system, with respect to key functions and linkages as defined by the conceptual model for this research, as well as to measure specific outputs. Because these functions, linkages and outputs tend to be operationalized at the research program level, rather than for the system as a whole, four commodities were selected *a priori* for analysis in this case study. In each country case study, the decision was made to study the main food staple, the main protein crop and the main cash crop grown by smallholders.

In Malawi, maize is the main staple food crop and tobacco is the chief cash crop of smallholders. However, since groundnuts serve as both a cash and protein crop and *phaseolus* beans is an important protein crop both were included for analysis in this case study. In this section, each function, linkage and output indicator will be considered separately, including a summary of findings for each of the four commodities. Detailed information on these indicators and the findings for each commodity is available, but was too lenghty to include here.

R1. Access to External Technology and Knowledge

The capacity of the national system to access or borrow externally developed technology or knowledge from international agricultural research centers (IARCs), and other external research programs and institutions appears to be very important in accelerating the national technology development process. From a review of the literature, the following factors were frequently mentioned as central to a national program's

capacity to access external technology: (1) regular introduction or access to germ plasm and improved production technology, (2) the training of national research staff who can introduce and test improved technology from external sources and (3) consultations from IARC and other external scientists on all aspects of crop improvement.

Three of the four commodities studied (maize, groundnuts and beans) were found to have high access to international sources of genetic technology, primarily from International Agricultural Research Centers (IARC's). Receipt of new genetic technology was found to be low for tobacco. Regular access to IARC training was also high for all commodities except tobacco, where researchers had no access to external training.

Consultation with external or IARC scientists was considered to be high for all commodities. ICRISAT has a regional outreach office for groundnut research at the Chitedze research station. CIMMYT and CIAT scientists have regular contact with the maize and bean research programs respectively; and there are U.S. scientists working with Bunda college through the Bean-Cowpea CRSP. The FAO has expatriate scientists working with the Tobacco Research Authority (at least through 1986). The specific ratings for this indicator can be found in Table TD-9. The overall score for this indicator was 31 out of a possible 36 points or an index of 0.86. This is a very positive score. Also, the type of linkages the DAR has with different IARC's is presented in Exhibit TD-3.

Table TD-9: Ratings of access to external technology for maize, groundnuts, beans and tobacco*

Access to	Maize	Groundnuts	Beans	Tobacco	Total
Genetics	3	3	3	1	10
Training	3	3	3	0	9
Consultation	3	3	3	3	12
Total	9	9	9	4	31

*0-3 range, with 3 being most positive.

One concern that became apparent was the access of the DAR to private sector technology, especially pesticides. There does not appear to be a timely or systematic approach to accessing, testing and approving (or rejecting) agricultural chemicals for release. A somewhat ad hoc, passive and extended process of testing new materials seems to be the typical pattern, rather than the research system actively and systematically seeking to identify the most appropriate (i.e. safe, effective and low cost) technologies to solve farmer's pest problems. This issue is examined more fully in the "Flow" chapter.

R2. Research Activities

The number and type of research activities carried out by a national research system would be expected to affect its research output. However, the types of research activities carried out across different commodities and disciplines is so varied that it becomes nearly impossible to categorize, measure and compare research activity across national systems. Therefore, rather than attempt to develop highly aggregated activity measures that would be largely meaningless, an attempt was made to measure

research activity for the four selected commodities, across six major categories of technology (genetic improvement, cultural practices, plant nutrition, soil and water management, plant protection and post-harvest technology).

In Malawi, essentially all research resources are directed toward the development, testing and adaptation of technology for use by farmers. In comparing research activity by commodity, across specific categories of technology (see Table TD-10), it appears that genetic technology (varietal development and testing) is receiving the most research attention (total score of 31 out of a possible score of 36), followed by a similar level of research activity in the categories of cultural practices, plant nutrition and plant protection (24 each). The least amount of attention is being given to post-harvest technology (19) and soil and water management (15). These different levels of research activity appear to reflect current research priorities of this relatively small, but comprehensive research system.

Table TD-10: Relative Measure of Research Activity for Four Commodities in Six Categories of Technology*

Category	Maize	Groundnuts	Beans	Tobacco	
Genetic	8	7	9	7	31
Cultural	7	6	5	6	24
Nutrition	8	4	5	7	24
Soil & Water	6	4	2	3	15
Plant Protection	6	5	8	5	24
Post Harvest	6	3	4	6	19
Total	41	29	33	34	137

*Note: Based on a 0-9 rating, where 9 is the maximum score foe each category.

In terms of the relative level of research activity by commodity, these data tend to reflect the availability of research resources for each CRT. Overall, maize had a total score of 41 (out of a possible 54 points), followed by tobacco (34), beans (33), and groundnuts (29). Given available resources, it would appear that the commodity research programs in Malawi have a reasonable balance in research activity across the three steps of technology development, assessment and adaptation. It should be noted that with the introduction of the adaptive research teams (ART) into the ADDs, more clearly identified resources are now beginning to flow into adaptive research which is essential to fully exploit the new technology coming out of the commodity research programs.

R3. Research Outputs

Research output in industrially developed countries, such as the U.S., is generally measured in the annual output of scientific publications by scientist (see Boyce and Evenson, 1975 and Busch and Lacy, 1983). Busch and Lacy (1983) report that in U.S. state agricultural experiment stations since the Second World War, the relative importance of technical bulletins to scientific journal articles has declined dramatically.

It must be recognized, however, that the private sector conducts the majority of the applied agricultural research in the United States. Therefore, using scientific publication as the primary output measure does not adequately reflect the applied or technology development side of the research continuum. To measure these other types of research outputs, it

is necessary to include technical materials, bulletins and reports as well as some assessment of how these new technical outputs are made available to users, including intermediaries.

For this output measure, the number of scientific papers written, technical reports and materials produced, and extension bulletins written, workshops conducted, etc was determined for 1984. These data were collected for each of the four commodity research programs included in the analysis (see Table TD-11). These data in turn were aggregated and divided by the number of agricultural research workers in the country to produce a comprehensive indicator of research output for each commodity research program.

Table TD-11: Number of Knowledge and Technology Outputs by Selected Commodities for 1984-85

Output Measure	Maize	Groundnuts	Beans*	Tobacco	Total
Scientific knowledge generated (papers published)	0	0	5	5	10
Technical materials and reports produced (e.g. varieties released, new recommendations,etc.)	10	1	4	11	26
Technology transferred to users (workshops, demonstrations, etc)	45	55	9	55	164
Total	55	56	18	71	200
Number per professional/year	8.0	8.0	18[a]	7.1	8.0

* 1.0 FTE professional assumed at Bunda College; however, this may understate the research effort because of the technical assistance provided under the USAID funded bean-cowpea CRSP.

As can be seen from Table TD-11, the majority of research outputs fall into the categories of technology developed and transferred to farmers and

intermediaries (such as extension). The overall output per scientist was 8 units which would suggest that these are highly productive research programs.

R4. Access to Feedback from Transfer Personnel and/or Farmers

A commonly shared viewpoint (Pinstrup-Anderson, 1982; Rogers, 1983 and Compton, 1984) is if research personnel are to stay focused on important farmers problems, they need continuing feedback from farmers and/or intermediaries who perform the technology transfer function.

This indicator was structured to measure the relative frequency of both formal and informal contacts with farmers and technology transfer organizations (i.e. extension, input suppliers, as well as sources of agricultural credit and marketing agencies). Formal contacts were considered to be any types of planned meetings, workshops, field days and so forth, and were considered more important (weighted by a factor of 2).

The estimated levels of feedback for the four commodities are found in Table TD-12, which follows. As expected, informal sources of feedback were more common than formal sources. Also, since tobacco is an industry supported research program, it had the highest level of access to feedback. To keep research fully focused on important farmers problems, it is essential that both formal and informal sources of feedback remain high.

Table TD-12: Frequency of Formal and Informal Feedback by Commodity*

Sources of Feedback	Maize	Groundnuts	Beans	Tobacco	Total
INFORMAL FEEDBACK					
Farmers	2	1	2	3	8
Extension	2	2	3	3	10
Others (ADMARC, NSCM)	1	2	2	2	7
Subtotal (Informal)	5	5	7	8	25
FORMAL FEEDBACK					
Farmers	2	1	0	2	5
Extension	2	2	0	2	6
Others (ADAMARC, NSCM)	1	1	1	2	5
SubtotaL (Formal)	5	4	1	6	16
Formal x 2 =	10	8	2	12	32
Total	15	13	9	20	57

*Scoring based on a 0-3 range, with 3 being the most adequate level of feedback. The highest possible feedback score for each commodity, including the weighing for formal feedback, was 27.

Summary and Conclusions

The agricultural research system in Malawi has made considerable progress since independence. It has moved from a small, expatriate directed and staffed research organization, with only two Malawian research officers, to an expanded system, involving about 200 professional officers, 80% of which are Malawian. With the exception of the Tea Research Foundation, which is a quasi-regional research organization, the research system is directed by senior Malawian scientists and administrators.

The research system itself is highly focused on applied and adaptive research aimed at technology development, rather than emphasizing disciplinary research. Furthermore, the system has excellent ties with international agricultural research centers (IARCs) and a few other national and international research organizations with and active view toward borrowing new technology. Its linkages with private sector sources of technology are less well developed.

The organizational structure of the Department of Agriculture Research (DAR) was substantially changed in 1984 to allow more national direction and control over this central component of the research system. Although the previous organization appeared to be quite productive, the new organization will more clearly link the DAR to national agricultural development objectives, improve resource allocation to priority research programs, place scientific leadership in the hands of the most highly trained and competent researchers, and substantially improve the linkage between research and extension.

The allocation of resources to agricultural research was estimated to

be about 0.72% of agricultural gross domestic product (AGDP). Research expenditures appear to be growing about 5% annually in real terms, but with 3-4% growth in the agricultural sector, the relative level of national investment in agricultural research remains essentially stable. Increased national investment in the research system appears justified, in addition to staying slightly ahead of agricultural sector growth.

The allocation of resources between commodity research programs is relative good, however, several key commodities to the national agricultural economy may require immediate additional resources. These programs include the main food staples of maize, cassava and sweet potato, as well as the important export crops of groundnuts and tobacco. Agroforestry needs immediate attention and adaptive research needs additional staff, particularly at the technical support levels; ARTs also requires immediate staff development efforts. Although these research programs may need immediate attention, it is not recommended that sound existing research programs be partially dismantled to achieve this objective. Programs needing attention should be strengthened as new resources come into the system.

The research system is clearly moving toward both extension and the farmer. The formal addition of the adaptive research program will increase the system's capacity to assess farmer resources, constraints and needs. It will also enhance the system's capacity to more effective integrate technology from the commodity research programs and modify the recommendations to the production and economic conditions of farmers, Clearly this is a young research program with relatively inexperienced

staff. However, the basic elements are in place and at least one ART is already operating successfully. As this program is strengthened and begins to mature, it has the potential to greatly enhance the effectiveness of the system.

The procedures by which new technology is approved for release to farmers is covered more adequately in Chapter 6. However, with the creation of the ARTs, the approval process for technical recommendations appear to be a constraint to the development of location specific technology. Clearly genetic materials and new agricultural chemicals must continue to be fully tested and approved before release; however, the concomitant cultural practices and other technical recommendations must be modified to fit local needs and conditions. This is the primary role of ARTs and this information should be fully shared with both Extension SMS as well as with the Program Manager in each ADD, so that packages approved for credit will reflect these local needs.

The relationship of the system with private sector sources of technology needs to be carefully examined. In particular, the private sector is the major source of new agricultural chemicals. While these types of inputs are costly to import, they can greatly increase the productivity of the agricultural sector. This issue is discussed more adequately in the chapter on "flow of technology", however, there is a clean need for systematic procedures for testing and approving new pesticides for use by smallholders. New generation materials are generally more effective, safer and sometimes less expensive than the chemicals that were approved both before and after independence. Small farmers should

have the opportunity to use safe materials, that can increase their productivity and incomes.

Overall, the agricultural research system in Malawi appears to be well organized and moving toward meeting the technology needs of farmers. The primary constraints appear to be largely resource based and the World Bank and USAID projects should help alleviate many of these constraints. In fact, the agricultural research system in Malawi appears well postured to make very effective use of these resources to strengthen both its human and physical capacity for future agricultural research.

Exhibit III-1

AGRICULTURAL PRODUCTION: VALUE BY COMMODITY AT 1978 PRICES

(MILLION KWACHA)

COMMODITY	1980	1981	1982	1983	1984	1985	TOTAL	Smallholder PERCENT	Overall PERCENT
I SMALLHOLDER AGRICULTURE									
MAIZE	71.10	70.63	76.46	81.52	83.25	80.51	463.47	30.3	21.4
RICE	7.86	4.12	2.46	2.55	3.44	3.63	24.06	1.6	1.1
MILLET, WHEAT, SORGHUM	2.53	1.72	1.57	1.42	1.47	1.47	10.18	0.7	0.5
CASSAVA-POTATOES	27.50	28.35	29.25	30.15	31.05	32.05	178.35	11.7	8.2
GROUNDNUTS (SHELLED)	40.78	28.92	25.60	25.60	25.13	28.92	174.95	11.5	8.1
PULSES-OILSEED	7.49	3.89	3.22	2.63	4.25	4.97	26.45	1.7	1.2
SEED COTTON	6.44	6.16	4.20	3.64	8.96	11.77	41.17	2.7	1.9
TOBACCO	9.49	11.21	8.63	8.63	16.39	18.12	72.47	4.7	3.3
FRUITS & VEGETABLES	42.86	44.19	45.58	46.97	48.41	49.92	277.93	18.2	12.8
LIVESTOCK	33.20	31.80	33.30	34.90	33.70	34.90	201.8	13.2	9.3
FIREWOOD	9.50	8.70	8.94	9.26	10.03	10.19	56.62	3.7	2.6
TOTAL	258.75	239.69	239.21	247.27	266.08	276.45	1527.45	100.0	70.4
II ESTATE SECTOR	1979	1980	1981	1982	1983	1984	TOTAL		
FLUE CURED TOBACCO	43.08	45.04	33.76	38.72	37.09	42.66	240.35		11.1
BURLEY TOBACCO	17.26	19.31	21.76	31.94	48.07	34.70	173.04		8.0
TEA	30.97	28.41	30.40	36.58	30.40	35.65	192.41		8.9
COFFEE	0.87	0.58	1.15	2.24	1.92	4.57	11.33		0.5
SUGAR	2.31	3.16	3.58	3.69	3.76	3.21	19.71		0.9
TOTAL	94.49	96.50	90.65	113.17	121.24	120.79	636.84		29.4
III FISHERIES AND FORESTRY									
TIMBER	0.29	0.29	0.26	0.23	0.26	0.28	1.61		0.1
FISH	0.30	0.29	0.27	0.26	0.32	0.29	1.73		0.1
TOTAL	0.59	0.58	0.53	0.49	0.58	0.57	3.34		0.2
GRAND TOTAL	353.83	336.77	330.39	360.93	387.90	397.81	2167.63		100.0
Value at current prices:	387.80	439.15	474.77	576.04	711.41	776.53			

Exhibit III-2: Donor-funded Agricultural Research Activities, 1984

Donor Country	Activity	Results	Expected Duration	Expatriate Technical Support (FTE)	Donor Contribution (US$)
United States					
USAID	Agricultural Research	Buidling, equipment and training of research personnel	1980-1984	8	2,265,124[a]
USAID	Bunda College Ben/Cowpea Research	Breeding of varieties of beans/cowpeas	1982-1985	1	87,399[a]
United Kingdom					
UK/TC	Tobacco Research Authority	Provision of Tobacco Plant breeder	1982-	1	47,656[b]
UK/TC	Tea Research Foundation	Provision of Biochemist and processing engineer	1982-	2	95,313[b]
UK/TC	Bvumbwe Agricultural Research Station	Provision of entomologist	1982-	1	47,656[b]
UK/TC	Chitedze Agricultural Research Station	Seed technology services, crop storage and farm machinery	1982	1	203,482[c] 20,462[d]

Exhibit III-2: Donor-funded Agricultural Research Activities, 1984 (cont.)

Donor Country	Activity	Expected Results	Duration	Expatriate Technical Support (FTE)	Donor Contribution (US$)
Denmark					
DANIDA/ FAO	DVS - East Coast Fever Immunization	Testing of methods of immunization in cattle against East Coast fever diseases	1982-1986	4	814,362
Canada					
IDRC	Bunda College Animal Nutrition Research	Mineral nutrition trends in natural forages	1984-1986	-	61,000
Others					
UNDP/ FAO	Tobacco Research	Technical assistance for tobacco research expert and tobacco engineer	1982-1986	2	958,389
UNDP/ FAO	DVS-Training	Provision of one fellowship in Kenya	1982-1983	-	11,095

[a]Resources available in 1984. The USAID contribution to the Department of Agricultural Research from 1980-1984 was approximately US$ 10 million and to the CRSP programme from 1981-1985 is approximately US$ 550,000.
[b]Initial contribution made in 1982, expended over several years until funds are exhausted. Subject to renewal.
[c]1980.
[d]1982

Source: Adapted from Manda, D.R.B., et. al. (1985). Agricultural Research Resource Assessment in SADCC Countries, Volume II: Malawi, p. 64-65.

Exhibit III-3: Summary of Professional Staff Effort by Commodity or Program Area, 1984[a]

Commodity-Related Program Areas	FTE[b]	Source of Funds	Percentage of National Research Effort
Food Crops			
Maize	5.8	MOA, Univ.	4.8
Sorghum	1.5	MOA	1.3
Millet	1.0	MOA	0.8
Cassava and Sweet potatoes	1.6	MOA, Univ.	1.3
Pulses (Beans, Peas)	1.5	Univ.	1.3
Other (Pigeon Pea)	0.3	Univ.	0.3
Rice	2.0	MOA	1.7
Wheat	2.5	MOA	2.1
Subtotal, Food Crops	16.2	MOA, Univ.	13.5
Commercial Crops			
Cotton	7.3	MOA	6.3
Sugar Cane	1.0	Sucoma	0.8
Fruit & Vegetables	6.8	MOA, Univ.	5.7
Tea	9.8	TRF	8.2
Coffee	1.2	MOA	0.8
Tobacco	11.0	TRA	9.2
Groundnuts	8.6	MOA, Univ.	7.2
Subtotal, Commercial Crops	45.7		38.0
Livestock/Fisheries			
Cattle beef & dairy	6.1	MOA, Univ.	5.1
Sheep	1.0	MOA	0.8
Poultry	1.0	MOA	0.8
Swine	1.3	MOA	1.1
Goats (meat)	1.3	MOA, Univ.	1.1
Veterinary	0.3	Univ.	0.2
Range management	1.0	MOA	0.8
Other (Animal nutrition)	1.3	MOA, Univ.	1.1
Pasture management	1.4	MOA, Univ.	1.2
Animal husbandry	1.0	MOA	0.8
Dogs (Rabies)	0.2	MOA	0.4
Subtotal, Livestock/Fisheries	15.9		13.0

Exhibit III-3: Summary of Professional Staff Effort by Commodity or Program Area, 1984[a] (cont.)

Commodity-Related Program Areas	FTE	Source of Funds	Percentage of National Research Effort
Other Program Areas			
Agricultural Policy (Economics)	9.0	MOA	7.5
Rural Institutions	0.2	Univ.	0.2
Biometrics	3.0	MOA	7.5
Other	30.5		25.3
Subtotal, Other Program Areas	42.7		35.5
TOTAL	120.5		100.0

[a]Professional staff are those with a BSc degree or above.
[b]FTE = Full Time Equivalent.

Source: Manda, R.D.B., et.al. (1985). Agricultural Research Resource Assessment in SADCC countries, p. 53-54.

Exhibit III-4

Linkages of Malawi's Agricultural Research System with International Agricultural Research Centers

Organization	Activity
CIMMYT	Provision of wheat and maize germ plasm and information and training from its farming systems research training centers in Kenya and Mexico
IITA	Contribution of support for cowpeas, cassava nurseries, and maize variety testing; conduct of training (at IITA) in crop agronomy; provision of assistance in the biological control of green spider mite and various mealybug pests.
ICRISAT	Assistance with training in groundnuts, pigeon peas, chickpeas, and sorghum production; provision of information and assistance from an ICRISAT regional sub-station for groundnut research (an activity that SADCC has proposed to CDA to be converted to a regional grain legume project).
ILRAD	Provision of vaccine to combat animal diseases
CIAT	Contribution to enable inclusion of *Phaseolus* beans in the grain legume programme.
ILCA	Provision of support for small farm animal power and small farmer dairy research
IRRI	IRRI staff visits and provision of new rice varieties for testing in Malawi
USAID/CRSP	Contribution of resources to enable Michigan State University's involvement in the bean and cowpea research project of the Department of Crop Production and Bunda College of Agriculture
OTHERS	Cooperation with the International Red Locust Organization, International Seed Testing Association (ISTA), and SADCC.

Source: Manda, R.D.B., et al (1985). *Agricultural Research Resource Assessment in the SADCC Countries, Volume B: Malawi*, p. 29.

Exhibit III-5 Educational Qualifications of Agricultural Research Personnel, 1984

Discipline Areas	Nationals								Expatriates								Total
	BSc		MSc		PhD		Subtotal		BSc		MSc		PhD		Subtotal		
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	
Plant/Soil Sciences																	
Crop sciences	1	8	–	3	–	3	1	14	–	1	–	1	–	7[a]	–	9	24
Agronomy	1	11	–	3	–	–	1	14	–	–	–	–	–	1	–	1	16
Crop physiology	–	2	–	1	–	–	–	3	–	–	–	–	–	2	–	2	5
Entomology	–	3	1	4	–	–	1	7	–	–	–	–	–	1	–	1	9
Horticulture	–	2	–	4	–	–	–	6	–	–	–	–	–	1	–	1	7
Microbiology	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	1
Nematology	–	1	–	–	–	1	–	2	–	–	–	–	–	–	–	–	2
Pathology	1	3	–	1	–	1	1	5	–	–	–	1	–	–	–	1	7
Range ecology	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1
Pasture	–	–	–	1	–	1	–	2	–	–	–	–	–	–	–	–	2
Seed technology	1	–	–	1	–	–	1	1	–	–	–	–	–	–	–	–	
Soils	1	3	–	5	–	3	1	11	–	–	–	–	–	1	–	1	13
Other (and general agriculture)	–	19	–	–	–	–	–	19	1	–	1	–	–	–	2	–	21
Subtotal, Plant/Soil Sciences	5	53	1	24	–	9	6	86	1	1	1	2	–	13	2	16	110
Animal Sciences																	
Animal sciences (general)	–	–	–	–	–	2	–	2	–	–	–	–	–	–	–	–	2
Animal breeding	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	1
Animal nutrition	–	–	–	–	–	2	–	2	–	–	–	–	–	1	–	1	3
Animal pathology	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	1
Animal physiology	–	1	–	–	–	1	–	2	–	–	–	–	–	–	–	–	2
Animal production	–	3	–	1	–	–	–	4	–	–	–	–	–	1	–	1	5
Other (health)	–	–	–	–	–	2	–	2	–	–	–	–	–	–	–	–	2
Subtotal, Animal Sciences	–	4	–	1	–	8	–	13	–	–	–	–	–	3	–	3	16

Exhibit III-5 Educational Qualifications of Agricultural Research Personnel, 1984 (Cont.)

Discipline Areas	Nationals								Expatriates								Total
	BSc		MSc		PhD		Subtotal		BSc		MSc		PhD		Subtotal		
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	
Other Disciplines																	
Agriculture/biochemistry	-		-	1	-	1	-	3	-	-	-	1	-	1	-	2	4
Agr. economics	1	8	1	4	-	1	2	13	-	2	-	-	-	3	-	5	20
Agr. engineering	-	1	-	1	-	1	-	3	-	-	-	2	-	1	-	3	6
Extension specialists	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	1
Food Sciences (human)	1	-	-	-	1	-	2	-	-	-	-	-	-	-	-	-	2
Information specialists	-	1	-	3	-	1	-	5	-	-	-	-	-	1	-	1	6
Rural sociology	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	1
Statistics	-	3	-	-	-	1	-	4	-	-	-	-	-	-	-	-	4
Systems specialists	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	1	2
Home economics	2	-	1	-	1	-	4	-	-	-	1	-	-	-	1	-	5
Farm management	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	1
Farm machinery	-	4	-	3	-	-	-	7	-	-	-	-	-	-	-	-	7
Mathematics and physics	-	1	1	-	-	-	1	1	-	-	1	-	-	-	1	-	3
Librarianship	-	-	1	1	-	-	1	1	1	-	-	-	-	-	1	-	3
Subtotal, Other Disciplines	4	18	4	15	2	6	10	40	1	2	2	3	-	7	3	12	65
TOTAL	9	75	5	40	2	23	16	139	2	3	3	5	0	23	5	31	191

[a]Includes two expatriates on the ICRISAT groundnuts research.

Source: Manda, D.R.B., et al (1985). Agricultural Research Assessment in SADCC countries, Volume II: Malawi, Devres, Inc, pp. 61-62.

Exhibit III-6

SUMMARY OF PROPOSED COMMODITY BUDGET AND RESEARCH STAFF ALLOCATIONS FOR 1985/1986

COMMODITY	Commodity Budgets TOTAL	PERCENT	RESEARCH STAFF PROF.	TOTAL	PERCENT
MAIZE	50,060	6.5	7	26	7.8
WHEAT AND BARLEY	23,480	2.6	2	8	2.4
RICE	39,960	4.5	2	11	3.3
SORGHUM AND MILLET	7,200	0.8	1	4	1.2
SUB-TOTAL	128,700	14.5	12	49	14.7
CASSAVA & SWEET POTATO	30,100	3.4	1	10	3.0
GROUNDNUTS	46,1[illegible]	5.2	7	21	6.3
OTHER GRAIN LEGUMES	15,700	1.8	4	9	2.7
BEANS (BUNDA)				3	0.9
SUB-TOTAL	61,800	7.0	11	33	9.9
VEGETABLES	17,550	2.0	1	15	4.5
TEMP FRUIT	29,150	3.3	1	6	1.8
TROP FRUIT	33,750	3.8	2	9	2.7
TREE NUTS	23,600	2.7	2	9	2.7
SUB-TOTAL	104,050	11.7	6	39	11.7
COFFEE	25,200	2.8	2	12	3.6
COTTON	90,250	10.2	6	22	6.6
ADAPTIVE RESEARCH	142,711	16.1	13	21	6.3
AGRI. ECON-DATA PROC.			4	6	1.8
SOILS & SOIL SURVEY	58,450	6.6	7	41	12.3
IRR & DRAINAGE	25,000	2.8	1	3	0.9
LIVESTOCK	72,600	8.2	4	15	4.5
PASTURES	23,600	2.7	2	9	2.7
SUB-TOTAL	96,200	10.8	6	24	7.2
AGRO-FORESTRY				4	1.2
FARM MACHINERY	19,600	2.2	3	7	2.1
CROP STORAGE	16,100	1.8	2	8	2.4
SEED TECHNOLOGY	17,800	2.0	2	2	0.6
TECHNICAL SERVICES	72,900	8.2	4	21	6.3
ADMINISTRATION/OTHER			12	31	9.3
TOTAL PROGRAM BUDGET	888,861	100.1	92	333	100.0
OVERHEAD (GENERAL OPERATIONS)	1,504,240				
TOTAL PROGRAM AND OPERATIONS BUDGET	2,393,101				

CHAPTER IV

TECHNOLOGY TRANSFER

OVERVIEW

The technology transfer system in Malawi encompasses the various extension units and personnel responsible for transmitting knowledge, skills and information to farmers, individually and through groups, and for assisting them in the utilization of this new technology in their farming systems. Extension is overlaid by a uniform orientation which emphasizes: 1) Farmer utilization of specific new forms of inputs and cultural practices, as articulated in the annual Agricultural Production Guide, and 2) reaching farmers in group settings, informally or in more formalized training programs. Although this is the common overriding orientation, extension/transfer activities are relatively decentralized and autonomous at the ADD level where a certain amount of flexibility exists for tailoring input packages and education program content to local needs and agricultural conditions.

The formal agricultural knowledge transfer system consists of approximately 1700 Field Assistants who are technically supported by approximately 60 crop and 15 livestock specialists, along with other supervisory staff at the Rural Development Project and Extension Planning Area levels. This staff serves the needs of 1.27 million small farmers whose landholdings average 1.17 hectares. This system is buttressed by a variety of professional staff operating at the national level including the Extension Aids Branch, subject matter specialists, and commodity research teams.

The emphasis in this section is largely on the knowledge transfer system which functions in the smallholder sector. The estate sector

functions differently, both in terms of the types of crops grown, and the distribution channels through which inputs and outputs flow. The analysis here has been circumscribed in other ways as well. In most societies indigenous information develops and moves informally through the agricultural sector. This type of transfer was noted in Malawi, particularly farmers awareness of seed varieties that have not been approved by MOA, and in some areas, their use of maize harvest technology that appears to have diffused from Zambia. Such transfers of information and small-scale technologies are not irrelevant to agricultural change, but their contributions, as well as levels of utilization, are difficult to assess. As a result, no attempt will be made to discuss indigenous knowledge transfer.

This study will focus on the government of Malawi's formal system for transferring technology and related information to the many dispersed smallholders. There is little transfer occurring through private sector institutions and firms and, consequently, the focus will be solely on the public extension system that is charged by the government with assisting smallholders in developing their potential and their living standards through increasing output, especially food and export crops. The primary concern is with promoting food self-sufficiency, especially across a broad base of smallholders, and through unused productivity. The mechanism by which this transformation is to occur is a combination of information transfer, technical assistance, incentives, and rural infrastructural improvements. Extension is thus a part of the overall strategy to get farmers to adopt new technical inputs and cultural practices. The extent

to which it has been successful can be observed in the portion of the study which examines farmers utilization of new inputs and practices (Chapter V).

The first part of this section will provide a brief overview of the extension technology transfer system, its mission, organization and the roles and responsibilities of the different operating units. The second part will examine the resources and other inputs which contribute to the on-going operation of the transfer system. The third part will examine various functions and linkages within the system; and the fourth part will assess some of the system outputs in terms of increasing farmer's access to new information.

A Note on Indicators

Throughout the case study, the emphasis has been on documenting system performance with reference to objective indicators. That pattern is followed here to the extent possible. Extension effectiveness, however, is not always easily captured in standard objective indicators. Morale, satisfaction and perceptions of adequate external support, for example, are frequently what vitalize an extension system, yet they are not easily assessed. More importantly, they are at best only indirectly inferred from objective measures such as turnover, absenteeism, and so forth.

At several points in this section, more subjective indicators are presented to give greater depth to the analysis. These amount to assessments provided by key-informants, individuals who are knowledgeable about extension, and who are in a position to provide information and insight that isn't easily established in objective indicators.

OVERVIEW OF EXTENSION/TRANSFER SYSTEM

Soon after independence in 1964, the Directorate of Agriculture was reorganized and an extension and training system was initiated. This was followed in late 1960s with personnel being given formal training and technical assistance in extension and communication. Two departments were created: the Department of Agricultural Extension and Training and the Department of Agricultural Technical Services. These two units were merged in 1978 into the Department of Agricultural Development (DAD). This merger paralleled the decision to undertake a National Rural Developmental Program (NRDP), which the new DAD was charged with implementing. At about the same time, it was decided to decentralize extension functions into the eight newly created Agricultural Development Districts (ADD's), and to integrate them with the Rural Development Project Areas.

In 1982, the Department of Agricultural Development was retitled to the Department of Agriculture and its responsibility was restricted to the "provision of extension, training and land husbandry services." More specifically, the overall mission of extension in the DOA is to provide an efficient extension and training service to smallholder farmers, with the aim of increasing crop production, attaining national self-sufficiency in basic food crops, improving the incomes of the rural population, preserving the natural resources of the country, enhancing nutrition, and helping to improve the utilization of both human and natural resources. At present, DOA responsibilities have expanded to include the provision and supervision of credit and conducting the women's programs. Overall, there are seven major functional responsibilities that fall within the purview of the DOA:

extension and training, including the women's programs; food and nutrition; land husbandry; credit; extension aids; marketing; and provision of inputs and crops, including horticulture. These functional responsibilities are organized into four programmatic areas, each headed by an Assistant Chief Agriculture Officer who reports directly to the Chief Agriculture Officer. Chart 1 shows this organizational structure within the Ministry of Agriculture. These national program officers develop guidelines for in-service training within the ADD's, articulate national program policy, and approve techniques and methods for dissemination of information to farmers. Counterparts in each ADD help carry out these programs within the guidelines established at the national level. In addition to administering personnel in its various program divisions, the Department of Agriculture also provides administrative support on matters involving transfer, evaluation, and promotion of extension subject matter specialists within ADD's, even though they do not administer them directly.

The four program divisions within the DOA are:

1) Extension and Training: This division, in addition to training, includes women's programs, credit and inputs and marketing. There are two staff persons in extension and training, one in women's programs and two in credit, who are responsible for inputs and marketing. Staff are technical personnel who maintain liaison with various divisions, help implement national policy, advise the Chief Agricultural Officer on teaching techniques and methods, offer consultation and advice to counterparts in the ADD's, and conduct national training programs. The latter amount to at least one program

each year for about 30 field assistants of one month duration.

2) The Crop Division has one subject matter specialist in each of five areas: cereals; legumes and oil seeds; tobacco; cotton; and crop protection. These specialists are responsible for maintaining linkages with research personnel in order to get access to research information. They also counsel with researchers on farmers' needs, maintain contact with industry counterparts, help prepare technical recommendations, and provide training and technical backstopping for field operations.

3) The Land Husbandry Division provides technical services to help with land development, natural resources and conservation. Counterparts are located at several points in the extension system.

4) The Extension Aids Branch produces radio programs on a regular basis, develops films, maintains and provides 18 mobile vans, and editorial and production services for instructional aids and publications. Each Agricultural Development District (ADD) is linked to the Extension Aids Branch through assistants who provide information for inclusion in radio programs and other media.

Extension Organization

Extension in Malawi is decentralized into eight ADDs and 28 component Rural Development Projects (RDPs). Each ADD contains 2 to 5 RDPs which are designed to provide rural infrastructure as well as a variety of services to approximately 25,000-30,000 farm families. RDPs are further divided into 8 EPAs (Extension Planning Areas) each, and each EPA is subdivided into 5-10 Sections of relatively homogeneous agro-ecological conditions.

Each section is staffed by a Field Assistant who supposedly works with 450-800 farm families, although in some areas the number is more than twice that figure. As one might expect, the field assistant/farm households ratio is highly variable across Districts, and perhaps even more so if vacancies are taken into account.

At the ADD level the Program Manager is responsible for the administration of all programs and personnel, including extension, and for making budget allocations. However, extension personnel are technically responsible to the DOA for carrying out extension programs within a set of national guidelines. In each ADD, there is a Senior Extension Officer assisted by a training officer and extension subject matter personnel. Typically, there are seven extension specialists in an ADD, although the number and subjects they cover may vary depending on local farmers needs. The term subject matter specialist (SMS) is broadly used to cover all national, ADD, RDP and EPA staff that have any type of specialized role, regardless of education and training qualifications. Land husbandry and credit specialists are included with extension crop and livestock specialists. Staff with M.Sc. degrees, B.Sc. degrees and diplomas, and occasionally certificates, are included when the term is used in this study.

The Senior Extension Officer, who administratively reports to the Program Manager, has primary responsibility for carrying out the extension function. The subject-matter specialists (SMS) link up with the various Rural Development Projects to provide in-service education and technical support to the SMS staff at that level. They may also visit farms and help

backstop the system at that level, although the lecturing role is very dominant, especially since the introduction of the Training and Visit system (T and V).

Each of the eight ADD's has between two and five delineated Rural Development Project (RDP) areas. Some of the (RDPs) have completed 15 years of external support and now receive only funds from the Government of Malawi, some are mid-way through donor support, while others are just entering the funding cycle. Still others are programmed for donor support at some point in the future. At any given point in time there are wide differences among RDP areas, with the level and duration of funding being critical factors in providing assistance to farmers.

Rural Development Projects are comprehensive, integrated rural development activities with extension as one of their functions. There are 28 Rural Development Projects, with four not yet funded. They are administered by a Project Officer holding the rank of Chief Technical Officer or Professional Officer (CTO/PO), and an Assistant Project Officer holding the rank of Senior Technical Officer (STO). These are general officers and carry out many functions in addition to extension.

There are usually about five extension specialists at the RDP level, concentrating on crops, livestock, women's programs, land husbandry and credit. In some cases, there may be an added emphasis on a particular crop or area such as tobacco, cotton or horticulture. SMS's work directly with the Extension Planning Area (EPA) staff in developing their extension plan of work. They may also assist the EPA with in-service education and, in the case of land husbandry, providing technical supervision of service

personnel in the EPA.

The Extension Planning Area (EPA) is the basic extension unit for developing extension programs and an annual plan-of-work. Plans-of-work are developed at the EPA level with help from RDP personnel, and are then transmitted through the RDP for approval at the ADD level, and, eventually to the Chief Agriculture Officer of the Department of Agriculture.

Each EPA is administered by a Technical Officer (TO) and assisted by a Senior Technical Assistant (STA), who is generally an experienced certificate holder with a diploma in agriculture. There are 180 such EPAs in Malawi. At the EPA level, there are Subject Matter Specialists, but in function and training they are equivalent to specialized Technical Assistants (TA's). They have a two year certificate from the National Resources College and work directly with farmers, concentrating on land husbandry, credit, and the women's program, and occasionally on animal husbandry.

The Technical Officers (TO) at the EPA level supervise the Field Assistants (FAs) who are the direct link with farmers and farm groups in each of the five to eight sections which make up the EPA. There are also about 128 day-training centers where farmers, village leaders and officials and others come for one-day training sessions, including demonstrations. The extension field assistant works with local leadership in each village or block to enroll farmers for both residential and day-training courses. These residential centers are currently experiencing difficulties in enrolling farmers to carry out targeted training programs. Therefore, these facilities are being used more frequently for special training for

staff.

The Field Assistant's Extension Role

Several years ago, the government began promoting farmer groups and clubs, primarily as a means of facilitating farmer contacts with extension field assistants. Group and club functions were intended to be much broader, however. In addition to promoting the introduction of modern farming practices, groups and clubs were to encourage local savings, organization of communal work, procurement of credit for farm inputs, and mutual help in cases of death, sickness or disaster.

The basis of the farm group/club thrust was the realization that because of staff limitations and the failure of information to diffuse from "model farmers" to the general farm population, farmers would have to be reached in groups of farmers with similar interests, conditions, and farming problems. This approach is not without basis in theory, for group-dynamic research has shown that in addition to whatever efficiencies are associated with reaching a broader population with existing staff, group processes offer the added advantage of (1) support and reinforcement, (2) the strength of collective decision-making, and (3) peer-pressure to maintain agreed upon behaviors. Clubs are voluntary, but their formation is encouraged by field assistants and, as will be seen, membership is a prerequisite for receiving agricultural credit. Ideally, each club is to have 20-30 farmers, men as well as women, large and small farmers. The condition for club formation is that they have either a general interest in farming, or have a specific commodity interest. The clubs designate a meeting place, elect a chairman who serves as a "contact person" with

extension, adopt a constitution, assess fees, and stipulate other locally established conditions for membership. To be a member in good standing, farmers are expected to pay at least the minimum income tax and be a member of the Congress National Party. Field Assistants are expected to meet with the club every two weeks to provide technical advice and assistance in carrying out demonstrations on club plots.

While farmer clubs are intended to serve a variety of functions, a strong motivation underlying their formation is getting access to credit for members. Recently, club formation has been required as a condition for getting credit, and credit is in turn used as a lever for getting farmers to adopt recommended cultural and husbandry practices. Peer pressure and collective liability are relied on to ensure a high repayment rate, since receipt of future credit is contingent upon group rather than individual repayment. High credit repayment levels suggest that the strategy is effective.

Where it is functioning well, the group approach facilitates interaction between extension and farmer, and establishes a linkage frequently missing between extension and farmers. To get credit and inputs, farmers must function as a club, which in turn ensures regular extension contact and certification by extension field assistants, who are expected to ascertain if cultural practices are adhered to and/or adopted by club members.

The farmer club phenomenon has spread rapidly in all ADD's, although there are many areas where farmers have not yet formed clubs, and some where they probably will not. These latter farmers have been described in

one ADD as "Ruggeds" (rugged individuals) who do not believe in groups and prefer farming alone. Even considering the rapid formation of clubs, as shown in Table IV-1, a relatively small portion of the farm population is incorporated into a group being reached by this means. Also, the amount of credit received varies considerably across club members in different ADDs for example, ranging from about 90 kwacha/loan in Lilongwe and Mzuzu to only about 30 kwacha/loan in Ngabu, depending on the availability of credit from externally-funded projects and the number of farmers applying.

Table IV-1
Farmer Club Trends and Credit Received in Four Selected ADDs and Malawi

District	Number of Clubs	Club Members	Club Members	Total Average Loan (K)	Average Club Member (K)	Percent Change in Loan Per Members (1983/84-1984/85)
Lilongwe	2,422	68,311	28	2,536.4	89.9	7.1
Ngabu	539	11,681	21	659.4	30.4	6.7
Mzuzu	574	23,035	40	3,676.5	91.6	4.7
Liwonde	1,009	26,381	26	1,096.0	41.9	10.9
Malawi:						
(84/85)	8,148	211,770	25	1,960	75.4	--
(83/84)	7,191	180,256	25	1,611	64.3	13.0
(82/23)	6,654	156,703	23	1,284	54.5	--

While the club approach to technology adoption has distinct advantages, there are some obvious trade-offs. Since clubs have autonomy with respect to who they include in their membership, it is inevitable that a certain amount of selectivity would enter into who is and is not admitted. There is reason to believe that the very small farmers,

newcomers to an areas, and farmers who for one reason or another are defined as "risks" would not have ready access to a club. Informants claim that FAs try to influence composition to some extent by getting women and smaller farmers into clubs, and visits to a couple of clubs attest to fact that there has been some success in getting female farmers into clubs.

In addition to the issue of relative access to club participation, there is the broader question of how the club emphasis shapes subsequent FA behavior. In one ADD it was pointed out, for example, that FAs concentrate a disproportionate amount of their attention on club members, particularly those receiving credit (not all receive credit; some join but choose not to take credit). As a result, other farmers tend to be ignored. A related accusation concentrates on the cash-crop emphasis implied in the club approach. Since club members have larger areas under cultivation they're also more likely to be producing cash-crops, yet only a very small proportion of land (18 percent) in Malawi is devoted to cash crops (USAID, 1984:32). As a result subsistence crops get less attention from extension.

There is not the research base with which to substantiate many of the claims about the benefits and costs of pursuing an extension strategy based on club participation. On the surface they seem to work, at least for the segment of the farm population involved. How effective the clubs are in carrying out the non-credit functions, in generating capital for future investment, and in promoting recommended cultural practices remains to be demonstrated.

A general indicator of farmer access to technical knowledge, credit and inputs via farmer clubs could be expressed in terms of the proportion of

households in farmers clubs. In the case of Malawi in 1985, the figure is 18.6 percent.

Role and Time Allocations of Field Extension Staff

The field assistants are the only extension staff at the section level, consequently they have primary responsibility for establishing farmer contact. As indicated earlier, staffing ratios are relatively low compared to many other countries. Project funding, however, is probably the most important factor in explaining staffing differences between ADDs. When outside funding ended in Ngabu, the local budget was overwhelmed by salaries, indicating the difficulty that Malawi may have in maintaining these ratios as RDP funding diminishes or terminates.

The extension TAs in farming spend roughly 80 percent of their time in various educational activities. There are also credit TAs, but they handle the extension of credit from the EPA level. However, since these credit TAs do not work at the section level, the regular "extension" TAs are obliged to carry out a number of credit certification and monitoring activities:

1) The section TAs meet with farmer clubs to support their readiness for credit.
2) The TAs certify that farmers have their basic field work done and are ready for credit and inputs.
3) The TAs monitor use of inputs and inform the credit TAs about irregularities so that the credit (inputs) could be withheld or other administrative action taken.
4) The extension TAs keep current on repayment, and meet with clubs and groups to urge repayment.

The TAs extension have a number of duties regarding credit that are not basically educational and could interfere with the desirable TA/farmer relationship (Benor and Harrison, 1977). The credit role varies across ADDs. For example, Lilongwe has about 4,000 clubs with about 20 percent of them receiving credit. The farmers in this ADD receive about 40 percent of all credit and although Lilongwe has a TA/farmer ratio of 1:781, it was estimated that an average of 20 percent of the FAs time is spent on credit activities. Overall, only about 10 percent of the farmers in the country receive credit through extension. If the amount of credit were to increase and more farmers were given credit, this activity would probably overwhelm the knowledge transfer function.

It was pointed out by extension personnel that credit activities are normally integrated with regular extension activities and thus take a minimum of the extension TA's time. However, credit activities were estimated conservatively to require a total of two months a year. The demands of credit are probably tolerable now because ADDs like Lilongwe have a low TA/farmer ratio and there is limited credit available. In Mzuzu where there are fewer TAs, credit activities were already estimated to take about 40 percent of the extension TA's time. This raises the question as to whether extension is a viable system for extending credit in the future as this function increases.

In terms of time allocations, generally, the TA receives two days of training per month. Farm visits generally take another five days a month. There are also scheduled visits to clubs/groups and blocks, which on average take up about nine days a month. An estimated four days a month are spent on credit activities. TAs also spend time organizing and lending direct support

to new groups and clubs. On the basis of information provided by informants, a typical FA's yearly allocation of time to various extension functions would break down as shown in Table IV-2. As can be seen, almost two-thirds of the time (65%) is spent on direct knowledge transfer activities. It would be useful for extension to monitor changes in these time allocations over time (as credit activities increase), since the primary function of the FA is supposedly knowledge transfer.

TABLE IV-2

Types of Duties and Responsibilities of Extension Field Personnel

Duties and Responsibilities	Number of work days per year	% of time spend on each
Non-Knowledge Transfer Activities:		
a) Regulatory work (monitoring compliance of government directives/regulations		0
b) Data collection (census, crop forecasting, etc.)	3	1
c) Work on other government programs (subsidies, credit, input supply)	46	18
d) Servicing local government (settling local disputes, etc.)		
Knowledge Transfer Activities:		
e) Planning and conducting on-farm extension visits	57	20
f) Planning and conducting educational meetings	108	43
g) Other educational activities		
Planning and Support Activities:		
h) Preparing administrative reports	12	5
i) Attending in-service training	30	11
j) Other support activities	4	2
TOTAL	255	100%

FA Assignments

Sometimes field extension personnel do not live in their service area, which reduces their credibility and effectiveness (Watts and Claar, 1983). Another factor that can effect staff performance is frequent transfers or reassignments; or the opposite may also be true, where FAs are assigned to an

area and never moved, resulting in possible employee stagnation. Both of these factors can seriously impair the effectiveness of field assistants.

In Malawi all field assistants live within their assigned service areas, thereby avoiding any of the negative consequences associated with a differentiation between place of residence and place of employment. The second component involves the length of assignment in a given position. In Malawi it is the policy to leave people in one position 3-5 years so that they have time to plan and carry out program, while avoiding problems involved in remaining in an area too long.

The fact that few people are ever dismissed in extension creates that problem of what to do with the poorer field assistants. While it is the policy in Malawi not to shuffle personnel who have lost credibility from place to place, it is no doubt very difficult to resist moving them to another location, or perhaps worse, assigning them to a teaching position in a training center. The essential inability to dismiss people is likely to have some effect on extension efficiency.

The in-service education of field assistants is quite important (Moser 1978). In Malawi, they receive about 30 days per year. The fortnightly training is estimated to be about equally split between technical and professional instruction. TAs also receive training at research field days and at residential training centers. Overall, training is estimated to average 30 days a year: 24 days for fortnightly T and V, 2 field days plus 4 days at a RTC or other staff training center. This is a relatively high number of in-service education days. However, one hears of repetitive general messages that change little from year to year. Therefore, while the quantity of training

appears to be high, the quality of training was generally considered to be poor.

The Extension Function in Transition

The preceding overview of the organizational niche occupied by extension at various administrative levels reveals several important system characteristics which are necessary for an understanding of how transfer occurs and the roles the key personnel perform. First, the extension "system" in Malawi is decentralized. Various offices within the Department of Agriculture (DOA) at the national level have responsibility for leadership and technical support of extension work in their discipline areas, but extension programs are organized and carried out by each of eight Agricultural Development Divisions. The Program Manager of each ADD has full responsibility for administering personnel, allocating resources and carrying out programs.

Second, extension is directly involved in the credit system. It is responsible for disbursing credit through groups/clubs, maintaining the integrity of the credit system by insuring that specific preconditions are met and for seeing that inputs are correctly used and credit repayment is received. Although a separate cadre of credit personnel exists for direct administration of the program, they are not assigned below the Extension Planning Area level. Thus, the Extension Field Assistants (FAs) at the section level have a number of duties to perform, including credit which has high priority on their time.

Extension is in transition in Malawi from a system heavily emphasizing groups and clubs to a modified T and V system. It has been the policy of extension to work through groups since the 1970s and extension has shouldered the responsibility for the formation of groups. Some are loosely formed for

the purpose of facilitating FA-farmer contacts, while other are organized for the sole purpose of qualifying for and receiving credit. Some of these latter groups become highly organized and administer the credit, including seeing to it that the approved and recommended techniques of production are used.

The emphasis on groups/clubs continues as extension moves, at varying rates, to the modified T and V system. Since this is a transition period, it is more difficult to make definitive statements of the status of certain aspects of extension as well as the work of the extension FA who is assigned to work with both systems at the section level.

The existing groups/clubs will be part of the new block system but everyone in the block will be urged to attend bi-weekly meetings, and the groups/clubs are to receive no special attention at that time. However, the maintenance of the credit groups and working with them to determine credit worthiness and to insure that farmers pay back loans will still be an important responsibility of the Field Assistant.

EXTENSION INPUTS AND RESOURCES

All organizations, if they are to remain viable, require a regular infusion of inputs, either in the form of money to pay staff and develop new programs, or in the form of staff training to upgrade existing levels of knowledge and techniques. At the same time, there is need for supervision and staff evaluation to ensure compliance with extension goals and role requirements. The following parts of the present section examine, first of all, the staffing and training of field assistants and their distribution across ADDS. It then looks at personnel incentives and staff evaluation. This

is followed by an examination of budget allocations to extension, and, finally, staff training is examined with emphasis on subject matter specialists.

Staffing

The extension staff in Malawi has undergone dramatic growth. For example, in 1977/78 there were 1,010 technical assistants (TAs), while in 1985 there were reported to be 1,680 "farming" TAs, 238 "credit" TAs and 188 "farm and home" TAs working in extension at the various levels. It was not possible to secure consistent staff lists over time, since different lists of personnel vary according to whether established positions, all positions or only filled positions are counted. If the latter, the count may still vary depending on how soon the count was made after the graduating classes are employed. Also confusing is the recent reclassification of about 400 "development assistants" into the FA ranks. This accounts for much of the recent growth.

Based on data reported in the MacDonald report (September, 1985) there were 1,680 TAs assigned at the section level resulting in a field assistant:farm household ratio of 1:827. This figure is down from 1:1040 in 1982 and 1:882 in 1984. These data indicate that extension in Malawi is relatively well staffed at the farmer level. Benor and Baxter (1983) suggest for planning purposes an approximate ratio of 1:800 farmers. The most recent figure in Malawi of 1:827 compares quite favorably. However, the distribution between ADDs raises the question as to whether they are distributed to achieve the most favorable result. For example, the Ngabu ADD, according to the program manager has more field assistants than they can effectively deploy. The distribution of FAs across ADD, and their level of contact with farmers will be discussed in the final portion of this chapter.

Table IV-3 provides a relatively detailed breakdown of all established technical posts in the Department of Agriculture for 1984/85. It must be pointed out that these are "established" posts and under normal attrition, a percentage will always be vacant. However, the acute shortage of more highly trained personnel resulted in from one-fourth to over one-third of all specialized positions at the national level being vacant in 1985. In fact, for the superscale (SS) positions at the national level, at least one-third of these positions were vacant in 1985. At the ADD level, it was reported that 14% of all senior technical officers/technical officers (STO/TO) and professional officers/chief technical officers (PO/CTO) positions were vacant, as well as 9% of all senior technical assistant/technical assistant (STA/TA) positions. Therefore, when considering the data in Table IV-3, it is important to note that the actual number of extension personnel on-the-job was somewhat less than these numbers.

Table IV-3

Established Technical Posts in Department of Agriculture
and in Agricultural Development Districts 1984/85*

	SS	PO/CTO	STO/TO	STA/TA	TOTAL
I. Agricultural Administration and Management					
A. Dept. of Agriculture	2				2
B. ADD	8	28	223	208	467
SUBTOTAL	10	28	223	208	469
II. Crops Extension					
A. DOA	8	6		3	17
B. ADD	10	23	36	1969	2038
SUBTOTAL	18	29	36	1972	2055
III. Support Personnel: Extension Aids and Training					
A. E.A.B.	4	2	14	34	54
B. Training	—	4	4	—	8
SUBTOTAL SUPPORT	4	6	18	34	62
IV. Land Husbandry					
A. DOA	5	8	5	8	26
B. ADD	5	25	33	266	329
	10	33	38	274	355
V. Credit					
A. DOA	2	2			4
B. ADD	—	5	34	224	263
	2	7	34	224	267
VI. Women's Programs					
A. DOA	2	1			3
B. ADD	—	3	12	239	254
	2	4	12	239	257
VII. Livestock Extension and Services					
A. ADD	3	4	11	36	54
VIII. Forestry			10	28	38
GRAND TOTAL	49	111	382	3015	3557

NOTE: Purely administrative personnel, such as executive officers, clerical staff and so forth are not included in this table.

Source of data: Compiled from data included in Ian MacDonald and Associates, Ltd, (1985), Manpower Development and Training Needs Study, Volume I, Tables 3 and 4 on page 23 and Appendix III, pages 145-147.

159

The first category of personnel in Table IV-3 are essentially administrative personnel, although many will have technical training in agriculture. These categories include the 8 program managers for each ADD, the 28 project officers for each of the 28 RDPs and the STOs to head each of the 180 EPAs. At both the RDP and EPA levels there were some additional STO's or STA's who assist the program at these levels.

In this study the concern is primarily with personnel in crops and livestock extension, including those staff in extension aids and training. As can be seen in Table IV-3, there is generally one senior extension officer at the ADD level and one professional officer (B.Sc. level) for most RDP's who is assisted by about 1 diploma level crops specialist. Therefore, given the vacancy situation in 1985, there were an estimated 75 crops and livestock SMS (including those with degrees and diplomas) at the ADD level to train and backstop 1680 farm FAs in all areas of cash and food crops and livestock production, or a ratio of 1 SMS to 22 TAs (1:48 when only SMS with degrees are included).

It should also be pointed out that the 6 crops SMS at the national level are assigned to the following areas: cereals, grain legumes and oil seeds, tobacco, cotton, horticulture and plant protection. At the ADD and RDP level there is also some specialization, but there appears to be some serious shortages at these levels. For example, in some RDPs, it was reported that there may be a cotton or tobacco SMS, but none in cereals, grain legumes and oil seeds, or vice versa.

The other issue that merits attention is the fact that both professional officers (with B.Sc. degrees) and technical officers (with

diplomas) are classified as SMSs. In most countries, the minimum qualification for a SMS position would be a university degree, since they must liaise with research officers and be able to translate research and technical reports into extension messages that can be understood and explained by TAs in the dissemination process. If only those crops SMS with degrees are counted at the ADD level, then there appear to be less than 3 SMS/ADD on-the-job for all food and cash crops, including horticulture and plant protection. Furthermore, one of these crops SMS in each ADD will be assigned to work directly with the Adaptive Research Team (ART) as this program gets underway throughout the country.

It is difficult to compute a precise indicator to accurately reflect the number and quality of SMS staff. Given the minimum criterion set forward in the model, that SMSs hold a university degree and actually work in (agricultural) knowledge transfer, the following measures were computed: ratio of SMS to F.A. = approximately 35 SMS to 1680 FA or 1:48; or about 2.0% are SMS.

FINANCIAL RESOURCES FOR EXTENSION AND KNOWLEDGE TRANSFER

Annual government expenditures for agricultural knowledge transfer are difficult to determine, given the partial use of development account funds, which are generally designated for capital expenditures, for recurrent or operating expenses. In addition, since these development expenditures are largely made at the RDP level within each ADD, data on how funds are actually used (i.e. capital or operations) are seldom aggregated and even more rarely made available in public government documents. Finally, there is the methodological problem of separating knowledge transfer from other

expenses of the DOA, particularly from credit, land husbandry and other rural development activities.

Due to lack of comprehensive financial information on extension expenditures, a somewhat indirect approach will be followed, utilizing the fragmented data that are available. Because certain data are only available for one year, there is the obvious risk that this may be an atypical year. However, since the available data appear to be reasonably accurate, certain generalizations will be made about the level of financial resources available and how these resources are allocated. Even so, these conclusions should be used with caution until more comprehensive data are available.

Total Resources for Agricultural Knowledge Transfer

The only comprehensive data available to show the amount of development account funds being used for current or operating costs were for the fiscal year 1982/83. These data, which are found in Table IV-4 below, show that 42.3% of all recurrent expenditures for agricultural development were funded from the development account. Further analysis of these expenditures for each ADD showed that these were, in fact, operating expenditures and the allocation of these resources for salaries and program costs closely paralleled the revenue expenditures in each ADD.

Table IV-4
Total Recurrent Expenditures for Agricultural Development, 1982/83

Distribution and Source	Expenditure	Percent
Headquarters (revenue)	374,081	3.0
Extension Aids (revenue)	669,236	5.4
ADDs (revenue)	6,116,758	49.3
ADDs (development)	5,257,885	42.3
TOTAL	12,417,960	100.0

- - - - - - - - - - -

Source of Data: Malawi Government (1983). Smallholder Agricultural Extension Project: Project Preparation Document. Planning Division, DOA, MOA, p. 16.

As mentioned above, some ADD expenditures should not be directly categorized as knowledge transfer. Therefore, an approach was needed to estimate the proportion of expenditures going for knowledge transfer activities. Given the allocation of DOA staff by function in Table IV-3, it was estimated that approximately 75% of ADD expenditures could be charged to knowledge transfer, plus 75% of headquarters and 100% of Extension Aids Branch (EAB) expenses. Therefore, for 1982/83, it was estimated that about 9.5 million kwacha were spent on knowledge transfer or about 2.2% of AGDP at current prices (averaged for 1982 and 83). If only the smallholder agricultural sector is included in these calculations, since they are the intended beneficiaries of this knowledge transfer system, then about 2.8% of smallholder AGDP is being invested annually in this function.

Another area of interest is the actual growth in knowledge transfer expenditures over time. Using growth in the DOA Revenue budget as a proxy indicator for measuring growth in knowledge transfer resources, it was calculated that knowledge transfer was experiencing about a 7.5% growth in real terms; the actual growth in the DOA budget (in current kwachas) was averaging about a 31%/year increase since 1980/81 (see Table IV-5 below).

Resources for Programs and Operations

One final area of interest, with respect to financial resources, concerns the proportion of the recurrent budget available for programs and

operations. The concern is that resources spent on salaries and personal emoluments must be kept in balance with resources for program and operations. This is particularly important for extension, so that the staff has adequate resources for transport, supplies, materials for demonstrations, teaching aids, communication expenses and so forth. Generally in a functioning system, it would be expected that a more or less equal amount would be spent on salaries and benefits as for programs and operations.

The allocation of resources in the DOA is provided in Table IV-5. Since 1980/81 there has been a general decline in program and operations funds from about 47% to about 37% in 1985/86. Simultaneously, the proportion of the budget spent on salaries has increased from about 50% up to nearly 57% over the same period. This shift in budget allocated to salaries appears to be closely connected to the build up in staff associated with the National Rural Development Program (NRDP), which was initiated in 1978. This corresponding shift in the allocation of resources away from program expenses and to salaries should be a matter of considerable concern. This is especially true, since over 40% of the recurrent expenses of the ADDs are presently being funded out of the development account, which is 89% donor financed as part of the NRDP. As the development funding cycle is completed for each RDP and ADD, more and more of these recurrent costs must be borne by government. Since it is difficult to cut staff, the common pattern is to cut the program budget, rendering the entire system ineffective.

Table IV-5

BREAKDOWN OF DEPARTMENT OF AGRICULTURE EXPENDITURES ON REVENUE ACCOUNT

Year	Salaries and Pers. Emol.	Program and Operations	Capital Expenditures	Total
1980/81	2,720,015 (50.2)	2,542,144 (46.9)	157,681 (2.9)	5,419,840
1981/82[a]	3,279,570 (42.5)	3,808,397 (49.3)	631,354 (8.2)	7,719,381
1982/83	4,584,011 (49.7)	4,201,164 (45.6)	435,709 (4.7)	9,220,884
1983/84	5,417,348 (53.9)	4,029,197 (40.1)	604,956 (6.0)	10,051,501
1984/85[b]	6,404,200 (55.1)	4,586,650 (39.4)	637,210 (5.5)	11,628,060
1985/86[b]	7,887,045 (56.6)	5,140,000 (36.9)	906,220 (6.5)	13,933,265

- - - - - - - - - - - -

Note: The grants and subscriptions portion of the DOA budget was not included in compiling this table.

[a] 1981/82 was an unusual year, due to higher than expected capital and program expenditures. The revised estimates for 1981/82 were more in line with previous and following years when 44.9% was actually budgeted for program and operations.

[b] Data for 1984/85 and 1985/86 are revised estimates and budget estimates, respectively.

Source of Data: Malawi Government. Approved Estimates of Expenditure on Revenue Account for the Financial Years 1982/83 Thru 1985/86.

One ADD has already completed the development cycle and is currently funded entirely out of the revenue account. In Ngabu, salary and personal emoluments were said to account for about 65 percent of the recurrent budget. The Program Manager reported that program operations were severely constrained at this level and he hoped to reduce staff (through transfers to other ADDs) to free up money for programs and operations. For example, field assistants and supervisors could not travel out to work with farmers because there were no travel funds. Given the situation in Ngabu and the current trend in the DOA revenue budget, it would appear that the DOA is becoming top heavy with personnel costs and it may already be facing serious problems in delivering effective programs and services to farmers.

PERSONNEL INCENTIVES

Employee motivation in public sector agencies, such as extension, is frequently stifled because of civil service rules and other bureaucratic procedures (Moris, 1981, ODF Occasional Paper #2). In other instances, extension might be poorly managed or lack sufficient resources to operate effectively. In this section, several measures of administrative procedure and incentives will be discussed in terms of their possibly limiting the effectiveness of various parts of the knowledge transfer system. Each indicator will be considered separately.

Salary and Benefits

The relative levels of salary and benefits are important personnel matters for knowledge transfer personnel throughout the world (Cernia, Russel, Coulter, 1983). The level of salary and benefits is one measure of society's relative value of the services provided (Lele, 1975). To get at least a rudimentary measure of this value, an indicator was developed around two factors: 1) the level of salary and benefits of extension personnel in relation to other comparable public service personnel categories; and 2) the overall level of salary and benefits provided in relation to what is needed to provide a reasonable standard of living for extension personnel and their families (Pickering 1983). Three categories of extension personnel are proposed for inclusion in this indicator: Subject Matter Specialists, Technical Officers and Technical Assistants.

On the basis of the responses, the aggregated salary and benefit indicator for extension personnel was calculated. As shown in Table IV-6 the evaluation of the salary and benefit measure were provided by key

informants on the basis of a set of responses ranging from "much lower than the comparison group" to "much higher than the comparison group". On the second indicator, "absolute level of salary and benefits", a similar five-point scale was used, with responses ranging from "a very poor standard of living" to a "high standard of living" relative to other families in the community. The responses for this indicator are given in Table IV-6.

Table IV-6

Comparison of Extension Salaries and Benefits

Personnel Comparisons	Relative Level of Salary and Benefits	Absolute Level of Salary and Benefits
1. Technical of Subject Matter Specialists (relative to research officers at regional experiment stations*)	"about the same"	"high standard of living"
2. Field Extension Officers or Agents (relative to secondary school teachers who lived in towns*)	"about the same"	"above average"
3. Field Extension Assistants (relative to primary school teachers who live in villages*)	"about the same"	"average standard of living"

*Note: A 1-5 scale was used, where 5 was high and 1 was low. Total scores could range from 6-30, with 18 being average. For this indicator, the "relative level" score was 9 and the "absolute level" score was 12, or an overall score of 21/30 = 70%.

In Malawi there appears to be a consensus that extension salaries are competitive with related professions. This is further supported by evidence from the National Resources College where several thousand applications were received for training as field assistants in the fall of 1984/85, when only some 300 students could be accepted.

Supervision and Evaluation

In addition to adequate tangible rewards in the form of salary and benefits, a well managed organization will have adequate numbers of supervisory personnel to provide professional counsel and guidance to field staff and assistants, as well as established procedures and criteria for evaluating personnel. Depending on the outcomes of the evaluation, there will also be a range of positive and negative sanctions to reward desirable performance and to penalize poor performance (Claar and Bentz, 1984; Ekpere, 1974 and Cernea, 1983). It is difficult for any organization to substantially influence employee performance in a positive way without such a set of administrative tools.

Personnel in the Malawi extension service are employed through the Civil Service system which provides for a job description, evaluation, and a reprimand. However, from extension's viewpoint, the evaluation process is especially devoid of incentives for excellence in performance or for acquiring advanced training. In the case of subject matter specialists in extension, pay is based on grades which can be reached by extension staff with a B.S. degree and there is thus little incentive to secure further training.

There is an "Annual Confidential Report" which is used to evaluate staff, but for all practical purposes all personnel receive the same pay despite a wide range of personal performances. There is an established procedure for reprimands which proceeds progressively up the system if the problems are not corrected. However, personnel are not dismissed, except for the gravest of behavior, with the result that those with poor

performance frequently continue to be promoted and receive the same pay as those who do outstanding work.

Table IV-7 presents a summary of informants' responses on a series of questions designed to elicit information on the presence/absence (yes-no) of specific types of personnel evaluation criteria. Responses to the items indicate that procedures are in place and utilized on a regular basis. However, positive and negative sanctions are considered to be inadequate. Therefore, large dividends might accrue to extension in Malawi if there were opportunities for rewarding and reprimanding extension staff.

Table IV-7. Personnel Evaluation Criteria

Item	No	Yes
There is an evaluation procedure specified and distributed		x
There is an annual written evaluation		x
Different supervisory levels may have input		x
TA is notified of evaluation		x
Procedure involves following counselling or training where needed		x
Supervision	**No**	**Yes**
Is there a reasonable ratio of supervision to field staff?		x
Are supervisors instructed to observe performance and provide counselling?		x
Do supervisors prepare evaluation and discuss them with employees?		x
Positive Incentives Criteria	**No**	**Yes**
Is pay distributed on merit basis?	x	
Does a considerable range in salary exist solely because of performance?	x	
Does extra training normally result in higher pay in the sam job?	x	
Are rewards dispersed on the basis of performance?	x	
Are supervisors encouraged to recognize excellent work on the job?		x
Negative Sanctions Criteria	**No**	**Yes**
Does the system provide for informal efforts to correct problems?		x
Does the system provide for written reprimands?		x
Does the system provide for punishment such as loss of pay?		x
Does the system regularly result in dismissal of incompetence that cannot be corrected?	x	

Staff Qualifications

The level of staff training is an important part of the resource base. In Malawi, the pool of trained manpower in agriculture was small at the time of independence. The lack of well trained extension personnel, especially SMS, is still a problem. Malawi has set up training requirements for the different positions in extension which include a specific qualification, or a lesser qualification with an additional number of years of experience. Table IV-8 indicates these qualifications and/or employment requirements.

Table IV-8
Types of Extension Positions and Qualifications

Category of Extension Personnel	Typical Qualification	Average Number of Years of Formal Education
1) Administrative/Supervisory Officers (PO, CTO)	B.S./Diploma	15/13 years
2) Technical Support Specialists (PO, CTO, STO, TO)	BS/Diploma[1]	15/13 years
3) Field Extension Officers/Agents (FED) (TOs, STOs)	Diploma	13 years
4) Extension Assistants TA, STA	Certificate	11 years

- - - - - - - - - - -

1 About one-third of the specialist staff have a BSC degree. These are mostly at headquarters and ADD levels.

The typical qualification of the extension SMS is of special concern since they are the technical base in extension. The Government of Malawi Extension Smallholder Support Project viewed the problem as follows: "There is no crops officer at headquarters, except for three or four tobacco and one cotton officers in the ADDs. The rest of the so-called

crop officers have little academic backing to enable them to liaise with research and formulate or extract technical information let alone train field supervisors as extension workers."

The extension subject matter specialist in most countries occupies a very critical role in assessing and preparing information for use in the field, and in training and backstopping field personnel. Since the information that extension disseminates originates outside of the organization, these linkages and training roles are critical to the quantity and quality of the information transmitted.

It has been suggested that the technical messages in extension are rather static from year-to-year and that some of the participants at the Residential Training Centers find the messages to be boring and repetitive. As evidence that this may be an accurate judgement, the Annual Survey of Agriculture indicates that a majority of farmers know what the extension service is recommending, even though they may not have adopted them.

Training of SMS

The training level of SMS's is approximately 35% with B.Sc. degrees and 65% with diplomas. This probably reflects the small numbers of trained manpower in agriculture at the time of independence and the fact that the incentives to secure additional training have been lacking. The import of this training situation is spelled out very well in the preparation document for the Smallholder Support Project (MOA Planning Division, Agr. Ext. and Planning Support Project, 1984). It indicated that: At the moment, the majority of the ADDs do not have the staff to formulate messages, and those that prepare messages and materials do so through their

own effort and experience, and not from an educational background.

Role of SMS

SMSs at the national level have a mixture of administrative and technical duties. At the ADD level, the Extension SMSs were not observed to be involved with field trials or demonstrations. The smallholder preparation document cited above, points out that since the inception of the T and V system of extension, SMSs have been reduced to the role of lecturer and trainer of the field assistants as they prepare messages for their fortnightly meetings. At present, extension is also identifying crops SMSs who will work with the adaptive research team in each ADD. In the future these SMSs will be more closely involved with adaptive research.

In summary, extension in Malawi has an extensive staff of field assistants who depend for program content and training on a very small SMS staff, most of whom are not adequately trained or linked with research, and who spend most of their time preparing and training the field staff in the messages they are to deliver at the fortnightly training meetings with farmers. As new technology is disseminated by FAs, farmers will have many questions and concerns that cannot be fully anticipated and covered in a training session or through extension publications. This need requires that extension have an adequate cadre of technical specialists who can respond to these questions and problems as they arise.

SYSTEM LINKAGES

An effective transfer/extension system requires numerous linkages, both forward and backward. Extension must, first of all either be capable of generating its own research and technology, which is unlikely, or be linked to firms and research institutions which perform that role. On the other end, there must be contacts and linkages with farmers for transferring information and also for getting information in return, or "feedback". Overlying the entire transfer process, however, there must be a staff that is sufficient in numbers and quality of training to carry out the various linking roles. By necessity, then, there is greater need for high level skills, in-service training, and backstopping by specialists in a system that is more fully integrated. The first section will sketch out various linkages which exist within the transfer/extension system and attempt to reach some judgments regarding its adequacy. This section is followed by the technical support function, specifically that provided by the subject matter specialists and the Extension Aids Branch (EAB).

Research-Extension Linkage

The gap between research and extension has been frequently identified in the literature as the most serious linkage problem of an agricultural technology transfer system (Maalouf, 1983; Compton, 1983; Mosher, 1978). A related problem exists, of course, where research is not producing a continuous flow of research information or technology. As a result, extension has little or nothing to transfer (Coulter, 1983). Either situation results in knowledge transfer system with little information or knowledge to extend to farmers.

An attempt was made to gauge the level and type of contact between sources of new technology, typically research institutions, and the knowledge transfer system, typically extension. In the following table, based on information from key informants in extension and research, the concern is with frequency and type of contact between the primary technology development and knowledge transfer institutions. In a well functioning system, a range of different types and levels of contact would be expected (Kang, 1984).

Since there are few objective indicators of extension-research contact one is left with getting subjectives estimates, which indicate, if nothing else, how those involved at the interface between research and extension see the situation. Five type of potential contact were identified in Table IV-9 and a composite of estimates based on responses is presented. On most of the types of contacts there is feeling that the level is "moderate" or "high". The perceived weakness is in the conduct of joint on-farm trials and demonstrations between extension and researchers. They take place on an infrequent and irregular basis and the feeling is that the level of contact through this avenue is "low".

Table IV-9
Informants' Estimates of Frequency and Level of
Contact Between Extension and Research

Types of Contact	Frequency	Level of Contact
Visits to research stations by appropriate transfer personnel	monthly	"moderate"
Joint on-farm trials/demonstrations conducted by research and transfer personnel	irregular	"low"
Technical publications received	annually	"moderate"

from research by transfer system		
Workshops/training sessions given by research on new technology	annually	"moderate"
Joint planning meeting between research and transfer personnel to develop and agree on technical recommendations	semi-annually	"moderate"

The reverse side of the research-extension linkage is the flow of information from extension to researchers. A widely accepted theoretical viewpoint is that extension, or the knowledge transfer system, is the central link in the feedback system from farmers to research (Compton, 1983; Cernea, 1983). In this capacity, extension is expected to collect, process and send information on major constraints, technological problems and farmer's needs back to agricultural research (Alleyne, 1975), where it is expected that appropriate changes and adaptations will be made.

Feedback to research is difficult to measure directly and accurately. Ideally, it would be helpful to know both the process and content of feedback; however, such detail of observation is beyond the scope of this study. Therefore, type and frequency of contact will be the main focus of attention, as was done in the previous table. Table IV-10 lists several types of formal contact which can exist between research and extension through which "feedback" can be carried out. Again, the estimates are a composite of different subjective indicators to measure the frequency of <u>formal</u> contacts. Informal contacts are also important, but, it is difficult to estimate their frequency.

Table IV-10

Formal Contacts Between Research and Extension for Purposes of Feedback

Type of Contacts with Research	Frequency
Meetings Between Administrative Personnel	monthly
Meetings Between Technical Personnel	weekly
Joint On-Farm Trial/Demonstrations	monthly
Workshops/Training Sessions Directly Involving Research Personnel	monthly

Two-way interaction between research and extension is an important dimension affecting the successful transfer of technology. In Malawi, at the national level, personnel in both extension and research are well aware of the need for a solid research-extension linkage and various formalized mechanisms have been established to effect it. For example, at the national level there is a research-extension administrative committee (referred to as the technical recommendations committee in the Flow Chapter) that reviews recommended new technologies and practices, and considers them for inclusion in the Annual Production Guide. As will be seen in the flow chapter though, the path to inclusion in the guide is often drawn out.

However, the information in the annual production guide is necessarily general and normally stated in fairly broad ranges; nor do the practices and recommendations change much from year-to-year, especially the cultural practices and suggested input usage. This places a great deal of responsibility upon the informal system and extension field personnel to modify the general recommendations for specific agro-ecological zones and other conditions.

In addition to the above, are also a number of other more formalized linkage mechanisms:

1. Research-Extension Meetings/Workshops - these meetings/workshops were new in 1985 and will be attended by national and ADD level research and extension personnel to discuss research findings, technical recommendations and generally provide for the two-way flow of information between research and extension. There are also expected to be counterpart workshops at the ADD level which precedes the national meetings/workshops.
2. Field Days - extension personnel are invited to see research work in progress.
3. Commodity Research Project Meetings - there are also expected to be commodity meetings at the ADD and national level where research coordinators discuss their findings and proposals for the coming year and elicit feedback. These meetings were also new in 1985.
4. Training - research personnel assist in extension programs, and back up extension personnel as problems are encountered.

It is obvious that there are considerable formal, and perhaps informal, linkages at the national level, both for feedback and transfer of knowledge. As one proceeds downward through the system, field days and linkage mechanisms exist, but effective linkage becomes more dependent on word-of-mouth and more casual methods of transfer.

There is some question whether the results of annual trials and experiment station activity are penetrating extension very well. One hears reports of boring, repetitive messages, groups disbanding because they did

not feel the meetings were rewarding, and farmers sending "representatives" to meetings, so they wouldn't have to attend themselves. Some of these problems may involve lack of creativity or competence on the part of the TAs in varying messages and making them interesting. But it also appears that few new relevant recommendations are being made to farmers, indicating that either the research system is not developing such materials or that it isn't reaching field personnel through SMSs and TAs in usable form.

The annual production guide is the primary source of technical information for field extension personnel. However, the guide's overall impact is difficult to evaluate, since it applies to the whole country. The recommendations are frequently presented in ranges and the ranges remain rather static from year-to-year. This could cover up significant opportunities for change for a given area. It may be that the Malawi Production Guide, which is meant to rationalize the system, is not reflecting the dynamics of the research program or serving as a sensitive linkage vehicle.

In an effort to develop more relevant, location-specific technology, adaptive research teams (ARTs) are being set up in all districts, although so far only four are in place. Extension is selecting a SMS, probably the ADD crops specialists, to serve in a liaison capacity with these teams. This action bodes well for the future. However, consideration may need to be given to adding crops SMSs to the ADD's, so that there would be sufficient crops specialists to work with the adaptive research team in different parts of the ADD. This would increase the number and depth of SMSs in crop production at the ADD level and put them in first-hand contact

with research.

At present, the paucity of subject matter specialists at the national ADD and RDP levels is clearly a problem in accessing information. By taking some steps as this, consideration could be given to having extension specialists taking more of the lead in field testing new recommendations and monitoring research trials thus permitting the adaptive research teams to put out more trials, covering a broader area. By having the ARTs work closely with SMS, they should be able to develop and annually modify economically viable recommendations for each agro-ecological zone in the ADD. Through such involvement, the SMSs should be able to acquire more information sooner, as well as sufficient depth of knowledge to package and adapt it for wholesaling during fortnightly training meetings with the field assistants.

In conclusion, two observed shortcomings were the lack of involvement of extension specialists in field trials and demonstrations, and a shortage of location specific technology available for dissemination by extension. The previous discussion and analysis suggests that Malawi has many of the basic formalized structures in place and that increasing the type and number of contacts should increase access to information. This assumes that as the quality of information goes up, the knowledge transfer process will function more efficiently.

Extension Aids Support and Mobility of Field Staff

The capacity of FAs to reach and teach farmers is enhanced or constrained by a variety of tools, ranging from transport or mobility, to communication equipment and the essential teaching aids and materials, or

software, that will enable an agent to communicate and teach effectively (Argus, 1983; Cher, 1981). These tools and materials are an important part of the program and operations budget that was discussed earlier.

Mobility of field personnel is an important factor in extension work. In a study by Sigman and Swanson (1983) it was rated as most serious in a list of problems ranked by directors of extension services in 60 developing countries. In Malawi, middle level supervisors (TOs) have motorcycles and TAs have bicycles. Loans are made to help staff secure these vehicles. Apparently, the newly hired TAs have difficulty in getting bicycles, since the cost is relatively high and the pay-back period is short. The range in the availability of bicycles across ADDs is high, with the Lilongwe ADD reporting essentially all TAs with bicycles, Ngabu very few, Liwonde 50-60 percent, and Salima two-thirds. Overall, the proportion of FAs with bicycles was estimated to be approximately 50-60%. This lack of mobility for nearly one half of the TAs is constraining extension work, particularly when one considers that even with bicycles, many farmers can't be easily reached.

Malawi has an Extension Aids Branch (EAB) which provides a number of services, including communications and teaching tools. This unit has a line item budget of about MK 600,000 (1985/86). Overall there are 54 positions in the EAB with 20 at the TO rank or above. However, in recent year, the EAB has been plagued by vacancies among senior officers. These officers represents the professional core of the unit with the rest of staff being in various production roles. The production equipment appeared to be old and limited, although the radio programming section had a

rationalized system for generating farm broadcasts. Recording assistants are located in the ADDs where they make recordings with farmers so that programs can be somewhat localized. Farmers that were visited and that had radios, said they listened to farm broadcasts and found the interviews to be informing and inspiring.

Ideally, teaching materials, publications and other software can increase the productivity and effectiveness of both SMSs and TAs. In addition, mass media can create farmer awareness of new technology, as well as reach larger numbers of farmers with timely information on production practices, marketing information and so forth. Therefore, an agricultural information unit can both complement and supplement the individual and group work of field staff (Evans and Dahl, 1983).

The indicator proposed to measure the capacity of a national extension system to produce mass media and teaching materials is expressed as the number of professional support personnel assigned to agricultural information duties in relation to field extension personnel. The professional backstopping personnel are in the Extension Aids Branch in Lilongwe, therefore, their ability to professionally backstop personnel within the ADDs with localized teaching materials would be quite limited. This is especially true since, except for recording assistants, there are no counterparts in the ADDS.

There are 20 professional/technical positions in the EAB at the TO rank and above. Assuming that these professional personnel are available for backstopping, the ratio would be approximately one staff person for 81 STA/TAs (based on 1680 FAs). However, since one-third of these EAB

positions have been vacant for some time, the actual ratio is closer to 1:130. In a study by Swanson and Rassi (1981) it was determined that the ratio worldwide was about 1:59. By this criterion, Malawi is understaffed with respect to professional level support staff who produce teaching materials, publications, radio programs and other mass materials.

TRANSFER SYSTEM OUTPUTS

The ultimate goal of any functioning information and technology transfer system is to reach farmers with new knowledge and to improve their decision-making. The expectation is that farmers will utilize those new technologies and practices that are appropriate to their needs, but the goal is broader than simply getting high adoption rates. To measure the efficiency of a transfer system, several factors should be considered, including its outputs, farmer contacts, demonstrations supervised, farmers trained, broadcasts aired, and, of course, farmers' utilization and adoption of new inputs and cultural practices. This section will address the broad issue of farmer access to information through various measures. A subsequent chapter will examine trends in utilization of new inputs and practices.

There are alternative means for getting information about recommended practices and new technologies to farmers. These methods, which vary in terms of cost and effectiveness, range from direct contact between farmers and extension staff, to more indirect methods such as mobile vans and radio broadcasts. In a well functioning delivery system these methods should be complementary. Personal, face-to-face extension contacts in individual and small group settings can provide farmers with demonstrations in the use of

the inputs and practices being promoted, provide close supervision of farmers' use of inputs and practices, and address specific problems farmers may be encountering. On the other hand, the media and other less direct methods for getting information to farmers are effective in informing, creating an awareness, and increasing farmers' knowledge of new practices and technologies.

There is little question about the relative superiority of one-on-one extension contacts, if extension assistants are themselves knowledgeable, have "relevant" information, and can transfer it to farmers. Extension contacts through farmer groups may be even more effective, for they incorporate the principle of peer-group support and reinforcement known to operate among friends, neighbors and family members in the adoption/utilization process. Still, research, including some done in Malawi (Perraton, et al., 1983), provides evidence that farmers do learn from radios, and other indirect methods. Moreover, these methods are relatively inexpensive for disseminating information, are generally regarded by listeners as important sources of information, and reach those who might not be reached otherwise.

In the following sections indicators are presented for four different approaches used in Malawi for providing farmers with access to information about new technologies and recommended cultural practices: (1) the volume of farmer-oriented radio broadcasts; (2) distribution of farmer groups and clubs; (3) levels of TA contacts; and (4) involvement of farmers' participation in formal training activities. Collectively, these indicators will permit an assessment of the extent to which the technology

transfer system is reaching farmers with information, as well as providing a baseline against which future performance can be measured. In the aggregate the indicators provide a relatively comprehensive picture of information- dissemination strategies used in Malawi.

Farm Radio Broadcasts

An examination of the farmer-oriented broadcast schedule, published and circulated by the Extension Aids Unit within the MOA, shows that six different programs are broadcast weekly, with the content changing according to the agricultural calendar. These radio farm broadcasts are listed in Table IV-11.

Table IV-11
Radio Farm Broadcasts

Broadcast/Title	Days Offered	Minutes/Week
"Modern Farming"	M, W	96
"Farm Forum"	T, F	96
"Farmers Voice"	Th	48
"Family Serial"	F, S	14
"Cotton Broadcast"	Tu	5
"Farmers Notebook"	Daily	30

Total weekly air-time is approximately 289 minutes. Many of these programs are repeats and about two-thirds of the broadcasts contain some or all technical content, meaning that they inform farmers of such things as need for and timing of weeding, as well as fertilizer applications, disease detection, harvesting and curing. Non-technical information disseminated on the broadcasts consists largely of farmers' stories, experiences, and

testimonials about how they solved particular problems or went about getting assistance with a problem. Non-agricultural topics are also covered on the broadcasts. These focus on such subjects as care of drinking water and nutrition during pregnancy.

Broadcasts cover the entire country and are in one language, Chewa. Program content is prepared by the Extension Aids Branch radio program staff which then checks the content with Ministry of Agriculture (MOA) researchers and extension staff. Extension Aids produces a program guide listing dates and content of programming, week-by-week for the entire year. The schedule is then distributed to all Field Assistants through Agricultural Development District (ADD) Project Managers. Field Assistants' (FA) comments and evaluation are solicited regarding farmers' reactions and topic relevance. Suggestions are also solicited for possible future broadcast topics. The FA's have the responsibility of informing farmers of forthcoming broadcasts and making arrangements for farmers to get access to the broadcasts. In some Districts this is done by having the FA assemble groups to listen to the broadcasts. This is an important activity since few farmers have their own radios. As an additional means of informing farmers and field assistants of forthcoming broadcasts, a schedule is printed in ZA ACHIKUMBE, a monthly farm magazine, which is sent to Project Managers for distribution to FAs.

Conversations with the Extension Aids staff reveals that there has been no evaluation regarding audience size, territorial coverage, or impact of broadcasts on farming in general. Extension Aids staff feel that listener response to "competitions" (contests) promoted over the radio is

evidence that broadcasts are being received by many listeners, although not necessarily by farmers. On the surface, at least, what appears to limit coverage are the different languages spoken throughout the country and the limited number of radios in rural areas. In both cases, however, these constraints are not as serious as may appear, if broadcasters assertations are correct that "all farmers can understand Chewa", and that FAs minimize the problem of access to radios by having group radio sessions during the broadcasts.

Table IV-12 presents several indicators to gauge farmer access to agricultural information through the media. However, these indicators are not able to provide an assessment of the actual use of such information in adoption decisions. Nor are indicators available for the full complement of vehicles used to communicate information, for example mobile van films and puppet shows, or for determining the quality of information disseminated. Nevertheless, indicators have been developed for several dimensions of broadcasting.

Table IV-12
Indicators of Farmer Access to Agricultural Information

	TITLE	CONTENT	ACTUAL MEASURE
1.	**Access/Media**	**Percent of Farm Households With a Radio**	**18%**
2.	Access/Language	Proportion of Total Major Spoken Languages in Which Agricultural Information is Broadcast[1]	20%
3.	Access/Volume	Number of Hours of Agricultural Broadcasting Per Week	4.8 hours
4.	Access/Content	Percent of Broadcasts With Technical Agricultural Content[2]	67%

[1]The percentage reported here undoubtedly understates access on this indicator. Recent census data show five major languages, ranging from 53% for Chewa to 8.5% Tonga. While Chewa is spoken primarily in the central portion of Malawi, by 94% of the population, and broadcasts would thus seem to be most relevant in that area, in reality it is estimated that 70-75 percent of the population understands Chewa.

[2]The determination of what is or is not technical is bound to be somewhat subjective. The present determination was made from looking at the titles and from conversation with Extension Aids staff.

In addition to radio broadcasts, the following list in Table IV-13 summarizes other media outputs from the Extension Aids Branch, 1984-85:

Table IV-13
Media Outputs from Extension Aids Branch

	Number
New Extension Publications	6
Different Extension Posters	5
Movies	4
Radio Programs	624
Posters (5,000) copies	5
Slides	400
Photographs	5,000
Flip Charts	100
Exhibits at Fairs	100

188

Understandably, output varies from year-to-year. A major annual publication, however, is the production guide. The publications from the Extension Aids Branch (EAB) are few in number. Of course, the EAB is not expected to initiate preparation of extension materials, but the linkages between extension and research personnel who are expected to develop such materials, are weak. Whether this factor affected EAB priorities or linkages to other groups was not clear.

Extension Contacts

Farmer clubs and groups[1] encompass a relatively small portion of farm households, as seen in the earlier indicator. Individual and block level contacts are still the mainstay of extension activity, and probably will remain so for some time. The extent to which such contacts are possible, at the block level or on a person-to-person basis, will depend largely on the number of field assistants relative to farmer households, the area which they must cover, and their mobility. Although the capacity of an extension system is typically expressed in terms of ratios of staff to farmers, it is not necessarily the case that a small ratio translates into

[1]Although "groups" and "clubs" are treated synonymously, there is a distinction in Malawi. Groups simply refer to collectivities of farmers who are interested in development activities for the village on a communal basis. Generally, groups are not highly organized; they are voluntary; and do not necessarily have an interest in credit. They may, however, evolve into a club which shares many of the above attributes, but, in addition is more organized and have an interest in getting credit for members.

more frequent contact or to delivery of qualitatively better information to farmers.

For example, considering the distance FAs frequently have to travel, often under adverse conditions, and their lack of access to vehicles in many cases, an equally valid indicator might be expressed in terms of a ratio of FAs to the farming area they have to cover. This may be a more realistic indicator of potential contact since Farm Assistants depend entirely on bicycles for transportation, and in some ADDs they have been slow in getting loans for bicycles. In addition, given the condition of some of the rural roads during the growing season, distance becomes a factor in establishing contacts. As a result one would expect that a FA density measure might be a more realistic, or at least an equally good indicator of potential contact.

On the basis of available data for 1984 the following indicators describe the density of FAs to: (1) farm households; and (2) to cultivated farmland.

ACCESSFAM = Density of Field Assistants in Relation to Farm Households
= FAs/Farm Households
= 1552:1,264,500
= 1:815
RANGE = 1:346 in Ngabu to 1:1419 in Blantyre, 1984

A proposed alternative indicator would be the density of FAs to cultivated areas.[2] For the nation:

2. ACCESSAREA = Density of Field Assistants in Relation to Cultivated Area
= Field Assistants: Cultivated Area (ha.)
= 1552:1,332,000
= 1:858 ha (1984)
RANGE = 1,590 ha to 1 FA in Kasungu to 370 ha. to 1 FA in Karonga, 1984)

The District (ADD) level ratios of FA/families and FA/cultivated area, are presented in Table IV-14. They capture the condition in each ADD, which can be seen to be quite variable.

Table IV-14
Farm Households, FAs, and Cultivated Area, and Extension Ratios, by ADD and for Malawi in 1984

Districts	Farms Households (in 1000's)	Cultivated Area (in 1000's)	FA	Extension Ratio FA: Farm Households	Extension Ratio Cultivated Area (ha)/FA
Karonga	31	31.8	86	1:360	370
Mzuzu	98.8	116.44	144	1:686	809
Kasungu	146.4	289.43	182	1:804	1590
Lilongwe	243.5	311.75	375	1:649	831
Salima	111.0	76.88	116	1:957	663
Liwonde	254.7	205.10	253	1:1007	811
Blantyre	296.6	211.45	209	1:1419	1012
Ngabu	64.7	89.15	187	1:346	477
MALAWI	1264.5	1332.0	1552	815	858

[2]The density of FAs to cultivated area indicator has some potential shortcomings. First, it is unlikely that FAs will ever have to oversee the entire cultivated area on a given farm. Second, if farm size in an area is high, an FA may actually have very few contacts. Nevertheless, in an area where there are many small, scattered farms, and crop diversity, an FA will be required to make many more contacts when the ratio is high.

Both the above indicators, at the national level, suggest fairly high ratios. One of the shortcomings of such indicators, however, is that they measure potential contact, or the probability of contact. The assumption is, of course, that where ratios are low there is likely to be more contact. The indicators overlook the more likely possibility that, regardless of the ratio, there will be few contacts, and that many of the contacts will be with the more accessible, more progressive farmers, as has been documented by several observers of extension activities.

The following data in Table IV-15 on extension-farmer contacts is taken from the Annual Agricultural Survey Data/1982-83 (unpublished). It permits an assessment, at the national level, of the actual levels of various types of contacts farmers have with extension. These data show that in a given year, in this case 1982/83, very few farmers had contact with FAs. Fewer than 5 percent had a field visit by the FA or attended one of the day courses offered to farmers. Slightly more had a personal visit or attended a demonstration. The most common type of contact was through a group meeting, which is what MOA is promoting with its farmers clubs and block-approach to extension in the modified T and V system. In that respect the approach is moderately successful, reaching about 20 percent of the farmers through at least one meeting per year. Since that is the approach being promoted, it could constitute an indicator which could be mentioned in subsequent annual surveys of agriculture. For example:

EXT. GROUP CONTACT = Percent of Farmers With Group Contact/Year
= 20.2%

Table IV-15
Farmers Indicating Level and Types of
Contacts with Field Assistants, 1982/83

Types of Extension Contact	Farmers Having Contact During Previous Year	"One-Time" Contacts
	----------percent----------	
Field Visit	3.5	66
Demonstration	5.8	44
Group Meeting	20.2	44
Day Course	3.6	52
Personal Visit	7.8	42
Residential Course	1.0	NA

An equally important indicator of contact is whether or not it is a one-time or recurring contact. The figures in Table IV-13 show that, with the exception of field visits, most contacts are repeats. The overall picture which emerges from the table thus suggests that relatively few farmers have contacts, but the contacts tend to be more intensive.

One of the common complaints against extension in Malawi, as well as in other countries, is that the smaller, poorer farmers tend to be neglected. As a result of the need to demonstrate progress and change, or to work with a subset of the farm population that is receptive to extension programs and advice, it is asserted that field assistants spend disproportionately more time with larger, more commercial farmers. Data assembled from a recent agricultural survey in Ngabu ADD and presented in Table IV-16, provides some insight into the types of farmers served by extension.

The data presented in Table IV-16 do not provide a clear-cut case that

smaller farmers are overlooked by extension. At the same time, the largest farmers -- those with three or more hectares -- do have higher than average contact on all measures except one attendance at demonstrations. A case can be made that extension is reaching a broad cross-section of farmers, at least in this particular ADD.

Table IV-16
Level of Extension Contacts For Ngabu, ADD, 1984/85

	TYPE OF CONTACT					
Farm Size	Any Contact	Personal Visit	Field Visit	Demonstration	Meeting	Day Training
	percent					
< .5 ha.	26	15	2	2	19	1
.5 to 1.0	22	12	3	6	18	0
1 to 1.5	24	4	2	3	22	1
1.5 to 2.0	25	8	5	5	15	4
2.0 to 2.5	21	4	0	5	14	5
2.5 to 3.0	20	18	0	0	14	5
3.0 and over	40	22	0	5	33	8
Total	26	12	2	4	20	3

Source: Annual Agricultural Survey (Ngabu), 1984/85. Unpublished data.

Farmer Training/Group Activities

The Ministry of Agriculture maintains two types of farmer training facilities, Day Centers and Residential Training Centers (RTCs). Day Centers have a demonstration plot for use during the training sessions, which last approximately two hours and consist of lectures, discussions and demonstrations. Training is done by DOs, FAs and FHAs. Farmers are generally selected for the courses by FAs and topics all given greater

coverage than is possible at the personal or group levels.

In each ADD there is also at least one RTC to which farmers and other village-level leaders come for a one to two week period for courses and demonstrations. Room and board are provided free to the trainees, and the courses are planned so as not to coincide with periods of extensive work on the farm. Courses are developed through consultations between the training committee and community and political leaders and ADD staff. Courses are intended to cover a variety of topics that are felt to be important either in terms of "bringing up" the skills of certain types of farmers or covering specialized topics, including such things as "leadership training". Farmer selection in one ADD is from among group village headmen, village leaders, Malawi Congress party members and "target" farmers. Data on the attendance at Farmer Training Centers is presented in Table IV-17.

Table IV-17
Attendance at Farmer Training Course,
by District and for Malawi, 1980/81

ADD	Farmer Attendance at a Training Course: Male Heads	Wives	Female Heads	Male Heads Attending a Residential Training Center
	percent			
Karonga	34	11	6	11.9
Mzuzu	30	15	19	15.5
Kasungu	36	16	12	8.3
Salima	3	13	13	6.1
Lilongwe	25	15	6	3.3
Liwonde	10	5	6	2.7
Blantyre	12	5	8	3.3
Ngabu	42	19	16	5.0
MALAWI	23	11	8	5.2

Source: National Statistical Office (1984). National Sample Survey of Agriculture 1980/81, Zomba.

Despite the large number of farmers who have been targeted for the course offerings offered at the ADD levels, relatively few have been served overall. Less than 4 percent have attended a day course and less than 1 percent have attended a residential course, as seen in Table IV-17.

It is obvious from talking to individuals at the ADD level and from examining ADD and project reports that the training targets are not being met. In some cases the targets are being missed by a wide margin, and farmer resistance has set in because it takes them away from their farms for long periods, often contains irrelevant material because the courses are aiming at too broad an audience, or the training repeats information farmers already know or have already received in other settings. One of the ADDs complained about the poor selection of farmers, for example, mixing cotton growers with livestock producers, and lack of staff training in holding farmers' attention.

Data from Ngabu ADD for 1984/85 show the striking discrepancy between established targets and actual achievements in getting training courses offered and farmers to attend the courses that are offered. Of the 1,358 courses planned only 831 were offered, and less than half the number of farmers targeted actually attended a course (14,553 out of 30,462). An annual report from another ADD noted, with respect to farmer training, that the "problem of recruiting the same people (repeaters) is getting out of hand ...." There are reports that some in some cases farmers who have been selected for training have sought out replacements, while others have not shown up.

Perhaps the training targets are too ambitious, and quantity is being

substituted for quality in the form of relevant, new information that farmers can use. Delivery style is also seen as a problem, with few of the staff having the teaching skills to hold an audience's attention.

While the data in Table II-17 show that farmer participation in training is relatively low, the situation in different ADDs is mixed.

For example, in Liwonde, relatively few male heads, farmer wives, or female heads have attended a training course. In others, Ngabu for example, the proportions are twice as high as the national average. In all Districts, however, it is clear that farmers' wives, and particularly female headed households were much less likely than male household heads to attend a farmer training course. In fact, female heads -- women who were the principal operator on their farms -- showed the lowest levels of involvement in a training course, even lower than wives of male farm heads.

The indicator which gauges the level of farmer participation in group activities comes from the 1980/81 Census of Agriculture:

ACCESSGROUP = Level of Participation in Farmer Training

= Number of Household Heads Receiving Training/Household Heads

= 19%

Demonstrations

Demonstrations and field trials have been found to be important in establishing credibility and motivating change. Demonstrations are an important instructional technique in Malawi. Groups/clubs at the block level have field demonstration sites on a farmer's field. It was estimated from visiting four ADD's that each TA averaged about 8.0 demonstrations per year (one ADD had only two per year because of transport problems; others

reported more, however, with one having 14 per year). Using eight demonstrations per year per TA would average out for Malawi as a whole one trial or demonstration for each 291 hectares of land under cultivation.

Summary

All the available data indicate a substantial amount of farmer contact. Although a minority is being reached, there seems to be no systematic bias in which farmers get access to information and contact tends to be on a recurring basis. The relevant ratios of field assistant to farm households and hectares of cultivated land are low compared to most African countries. Still the current direction of the extension effort toward groups and the provision/supervision of credit could begin to exclude certain segments of the farm population. In addition, certain aspects of the transfer effort need improvement. For example, training centers seem to be more concerned with numbers than with transferring new information and skills; mobility of TAs is hampered by inadequate transportation; there are relatively few SMSs to backstop FAs; and unrealistic target-setting appears to be the norm.

Chapter V

UTILIZATION OF AGRICULTURAL TECHNOLOGIES AND CULTURAL PRACTICES

Agricultural development entails the introduction and utilization of new forms of inputs and complementary cultural practices. In many countries various inputs and practices have been introduced and are known to farmers, but have not been adopted by more than a small segment of the farm population, or only after a lengthy delay. A body of research has accumulated over the years to demonstrate that there is a close relationship between a host of individual, farm-level, and infra-structural factors and farmers' ability and willingness to adopt new technologies and practices.

These determining factors have suggested several major functional requirements for expanding utilization of new technologies and cultural practices. The perspective employed in this portion of the report views the adoption/utilization of new inputs and practices as occurring in the context of: (1) farmers' access to and availability of new forms of inputs; (2) the quality and quantity of on-farm resources available to farm households; and (3) agricultural system incentives designed to make adoption/utilization more attractive. It is obvious also that farmers should have access to information about new technologies and practices. The extent to which farmers have access via extension assistants, the media, and farmers clubs and training were discussed in Chapter IV.

In this section of the report each of these three broad functional requirements is further differentiated and indicators have been proposed and operationalized. To be useful, indicators should permit measurement of the problems, conditions, and characteristics of a technology utilization sub-system, as well as provide a baseline against which performance in the

different functional areas can be compared over time. In the aggregate, indicators should facilitate making inferences about actual significant conditions related to technology utilization, and provide identification of longer term trends, periodic changes and fluctuations in rates of change. One further requirement for indicator development is that they be simple enough to use data already available, or which can easily be collected (Witkin, 1984). The indicators presented here are based on data obtained from secondary sources, published and unpublished, or based on information provided in reports or by knowledgeable informants.

ACCESS TO PHYSICAL INPUTS

Input supply and farmer access to new forms of inputs are critical utilization issues, especially since the emphasis in Malawi is being placed on increasing productivity through adoption of new inputs along with a set of recommended cultural practices. As indicated elsewhere in this study, the prospects for increasing production by cultivating additional land are limited.

Input supply involves establishing a delivery or transfer system through which inputs reach farmers in sufficient quantity at the required time. Input access, on the other hand, involves the allocation of new forms of inputs to farmers, who vary in size and in terms of resource endowments so that they can avail themselves of the inputs being promoted. Despite the apparent simplicity of a strategy which emphasizes utilization of new inputs and cultural practices, actual implementation of it is fraught with obstacles. New inputs have to be purchased off the farm, from a system of distribution points located spatially in some determined manner

across a heterogeneous farm population and landscape. And the inputs must complement one another. Under the best of circumstances this is no easy task, yet in Malawi the distribution system is quite well developed. Most of the problems that have been reported are problems of degree; occasionally delivery is later or inadequate given level of demand, but there were reported to be few instances of large-scale breakdowns.

The indicators developed in this section are designed to provide summary measures of the more important dimensions of the input supply and delivery system in Malawi. The critical agency in that system is the Agriculture Development and Marketing Corporation, ADMARC.

ADMARC is the major supplier of improved seeds, fertilizer and insecticides and other agricultural inputs in Malawi. ADMARC's level of purchase of various inputs prior to a cropping season is based on estimates of anticipated use and need which are generated at the ADD level. ADD estimates are, in turn, aggregated from EPA and second level estimates. Thus the extent to which purchases by ADMARC are adequate for a given season is in large part a function of the accuracy of levels of estimates. And estimates are bound to be off since it is difficult to estimate the amount of land that will utilize inputs, rates of application of inputs, amount of credit that will be available, intensity of extension activity, and so forth. Periodic shortages and late delivery of inputs have been blamed variously on inadequate seed production, transportation problems, in addition to somewhat erroneous estimates of seasonal needs.

At the farmer level, ADMARC operates a highly decentralized network of facilities, or distribution points, for supplying farmer inputs and

purchasing output. The "main markets" also serve as marketing depots for most commodities, and are generally opened throughout the year, unlike the "seasonal" markets. With the exception of some chemicals which are available through private suppliers, ADMARC is the sole source of recommended inputs.

Prior to each planting season a wide range of complementary input packages is put together at the ADD level for different crops. These packages are based on combinations of recommended inputs and tailored for a half-hectare area. In some cases, where inputs do not require a package (e.g. improved groundnut seed), these single-item inputs are available. The packages range in price and complexity, with the more costly and complex being restricted to the more "progressive" farmers, a determination made at the local level. Very little is known about how the input packages are created, how much research underlies them, or how they vary across ADDs.

The mechanism by which inputs reach the farmer is the "farmer club", which is composed of farmers who band together for the purpose of encouraging and supporting recommended agricultural practices, and for getting access to credit which is provided through the funded Rural Development Projects at the District level. Non-club farmers can and do use improved inputs. One ADD Project manager estimates that in that particular ADD 10 percent of the farmers operate with inputs outside the club system by paying cash. Recent data from the 1982/83 Annual Survey of Agriculture suggests, though, that perhaps close to half the farmers nationwide who use hybrid maize and fertilizer purchase the inputs with

cash. However, even the farmers paying cash for inputs are required to meet certain conditions before they are certified by the FAs to purchase them from ADMARC. The combination of inputs into a locality (ADD) - specific packages, certification by the FA that the farmer is eligible for and capable of utilizing a certain type of input or package, and the provision of credit - are intended to overcome many of the presumed obstacles to utilization and adoption of new technologies.

The key link in the system which brings farmers together with the input supplier, ADMARC, is extension, specifically, the field assistants and credit assistants. The FAs encourage and assists farmers in forming clubs through which credit and inputs are channeled. FAs verify that certain preconditions (primarily early garden preparation and ridging) are met before farmers are eligible (not all club members receive inputs or credit) for packages and credit. In addition, field assistants monitor farmers' use of the inputs and evaluate the extent to which they follow cultural practices.

Considering the field assistant - farmer ratio in many areas, either because of lack of bicycles, poor roads during the rainy season, or simply because of the distance they are required to cover, it is virtually impossible for them to ensure farmer compliance with recommendations. As a result, there are reports that fertilizer is occasionally diverted to local maize, and annual agricultural surveys provide evidence that many of the required cultural practices are not being followed. Still, the system seems to work well, with more fertilizer and other inputs being made available and utilized each year, more credit becoming available, and high

repayment rates.

Two of the main preconditions for utilization of new technologies and cultural practices is, first, farmer awareness that they exist and, second, familiarity with the attributes of the new inputs. A key indicator intended for use in the study was designed to establish farmers' levels of knowledge and awareness of the new inputs and practices. Discussions with key informants, however, raised questions about the validity and usefulness of such an indicator.

It was generally agreed among the persons with whom the issue was discussed that virtually all farmers are aware of improved maize and groundnut seeds, of the other physical inputs that complement their use, and of the recommended practices associated with each. This virtually universal awareness stems from the fact that recommendations tend to be uniform for a large part of the country, and have changed relatively little over the past decade. In addition, the thrust of extension activity, as reported at one of the ADDs has been on: (1) communicating what inputs have been available and recommended; (2) providing the same information over and over, and expanding to wider audiences; (3) being clear and consistent in the messages presented; and (4) changing the recommendations only when necessary, for example, upon release of a new variety or in response to a new disease problem.

Current estimates are that 90 percent or more of the farmers are aware of inputs and cultural practices that are being recommended. Data presented later from responses on a national survey show that unfamiliarity with inputs and practices is not a major obstacle to their adoption. As an

informant offered, "farmers know about fertilizer and how to apply it. However, not all have the resources to buy it or seed. Not all belong to clubs or funded clubs." In the particular case of this proposed indicator then, it is assumed that there is widespread knowledge of inputs and practices, and thus an indicator would not be relevant.

Input Supply

There are many dimensions of input supply and distribution, most of which cannot easily be examined with existing data. It is important to look at trends in levels of new inputs being made available to the agricultural sector, as is done here. If the trends are favorable, that is show increases, one might infer that more modern inputs are being supplied to farmers, and perhaps even to a broader segment of the farm population. At another level, however, there are numerous questions about the efficacy of the inputs, input supply relative to demand, the timeliness of availability, and the decision rules which distribute the inputs across the farm population. Few of these important issues can be addressed here.

Given the paucity of data, some rather gross assumptions will have to be made about the availability of fertilizer, improved seed, and pesticides, the three inputs being promoted among farmers. Indicators are framed in terms of aggregate supply, and trends are based on years for which data are available. It should also be recognized that averages based on longer time periods are more stable than on short periods, and that there may be inconsistencies in actual data, depending on the source of the data.

Fertilizer: The use of fertilizer has been expanding gradually over the years, as illustrated in ADMARC data for the past several growing seasons (Table V-1). The data show that, over the period covered, there was an annual 12.6 percentage change in fertilizer sales through ADMARC. However, there are sizeable periodic fluctuations. In two years the actual supply/sales decreased form the preceding year. However, on the assumption that an indicator ought to attempt to measure long term changes the following is proposed:

INPUTFERTIL = Fertilizer Supplied
= Annual Percent Change in Sales
= 12.6%

Table V-1. Total ADMARC Fertilizer Sales, 1976-77 to 1982-83

Year	Fertilizer Sales (in Metric Tons)	Percent Change From Preceding Year	Index (1976/77=100)
1976/77	30,661	-	100
1977/78	44,674	46	145
1978/79	44,378	-1	145
1979/80	49,142	11	160
1980/81	64,449	31	210
1981/82	56,307	-13	184
1982/83	57,763	3	188

Percent Change 1976-83 = 88

Average Annual Percent Change = 12.6

Source: Agricultural Production Guide, 1984/85

Table V-2 presents data on fertilizer supplies for the past five years, including figures for the three overlap years covered in Table V-1. Where there is overlap there are also slight discrepancies in the metric tons supplied. For the past five years supplies of all fertilizers are increasing almost 7 percent per year, somewhat under the 12.6 percent reported in Table V-1, which covered four additional years. More important, however, is the fertilizer demand, which is shown to be increasing at a rate of 30 percent per year over the last five years. The last column (Table V-2) shows the relationship between supply and demand for fertilizer. On an average basis, about 79 percent of the demand for fertilizer is being met over this period, suggesting the following indicators:

FERT/SUP-DEMAND = Proportion of Demand Met, Five Years
= 79%, Five Year Average

Table V-2. Fertilizer Supply-Demand Trends, 1980-81 to 1984-85

Year	Demand (Metric Tonnes)	Supplied (Metric Tonnes)	Percent Supply/Demand
1980/81	44,000	57,099	129.7
1981/82	59,000	53,120	90
1982/83	86,400	41,890	48.5
1983/84	102,000	57,380	56.3
1984/85	110,000	77,000 (est.)	70
Average Annual Percent Change	30%	6.9%	Five Year Average = 79%

Source: M. Mtika and K. M. Stawali, op. cit.

Recently released data on fertilizers, improved seeds, and pesticides that have been supplied through farmer groups exhibit several trends, as seen in Table V-3. Although the data cover only a few years, and only inputs supplied through farmer clubs/groups, they provide a fairly good estimate of recent trends. Fertilizer and the three most widely used pesticides all show sharp increases over the period, while "improved" maize varieties show a sharp decline of 18 percent. Supplies of the two hybrid varieties together, MH12 and NSCM41, have been fairly stable, showing only a minor decline. In terms of indicators of supply, the following serve as measures of actual conditions:

SUPPLY IMPROVED MAIZE	= Average Percent Change = -18%
SUPPLY HYBRID MAIZE	= Average Percent Change = 1.3%
SUPPLY: SEVIN	= Average Percent Change = 67%
D.D.T.	= Average Percent Change = 60%
D.I.M.	= Average Percent Change = 48%

Table V-3. Recent Trends in Selected Inputs Supplied on Credit Through Farmer Clubs

Inputs	Year 1982/83	1983/84	1984/85	Percent Change 1982/83-1984/85
Fertilizer[1]	455,844	443,271	693,534	52
Improved Maize[2]	204,325	100,572	111,342	-54
MH 12	107,177	84,312	96,714	-10
NSCM 41	--	1,729	6,107	--
Improved Groundnuts[3]	--	125	160	--
Insecticides[4]				
Sevin	791,725	1,433,922	2,385,935	201
D.D.T	446,951	909,287	1,252,633	180
D.I.M.	77,643	100,059	189,610	144

1 In 50 kg bags; includees 20-20-0, CAN, and S/A, sulphate of ammonia. Several other types are sold, in lesser quantities, in certain districts.
2 In 10 kg packets; includes two hybrids (MH12 and NSCM41) and two composites (UCA and CCA).
3 In kg includes Malimba.
4 In sacketts, kg, and liters; includes only three most widely used insecticides.

To a large extent farmers' access to inputs is contingent on club involvement, the number of clubs applying for credit and the availability of credit through the various rural development projects. It is believed, however, that few inputs are provided outside the auspices of farm clubs, and even club membership is not a guarantee of credit and thus the inputs which credit provides. In Lilongwe ADD it is estimated that approximately 20 percent of the farmer groups/clubs are funded, while in Liwonde at the present time all eligible groups are receiving credit. Nevertheless, the trend in fertilizer availability has increased dramatically over the past three years, while distribution of improved maize has declined by about the same amount (Table V-3). On the other hand, insecticide distribution has more than doubled over the past three years.

Input Distribution

The distribution of inputs always poses a problem because of the number of farmers and their scattered location throughout the countryside (Mellor, 1966; 294). In Malawi distribution is not as difficult as in most African countries, because of the fairly high population density. In addition, there is an extensive network of distribution points for handling inputs and marketing. As indicated earlier, inputs are provided in the form of "packages" which are distributed through ADMARC facilities located throughout rural areas. To use Lilongwe ADD as an illustration, for the forthcoming season inputs will be available to clubs in 30 different packages ranging in cost form MK107.8 to MK3.36. Four packages are available only to "good" farmers, while other single-item packages are available to "lower management" farmers. In between is a wide variety of packages.

Some of the ADMARC stations are "seasonal", with a small percentage of the "main stations" remaining open all year. It is estimated that there are 52 main markets/depots and over 700 local, often seasonal markets (World Bank, 1982:137). Farmers provide their own transportation to the facilities. Since ADMARC is the source of inputs, what is important as far as utilization is concerned is the distance farmers have to travel to reach a station. Proximity may be best reflected in a density measure of distribution points. Table V-4 presents basic data from which several distribution measures can be calculated.

INPUTDEN (1) = Density of Input Supply Points
= Farm Households/ADMARC Facilities
= 788 Households Per Facility, Nationwide

While the above measure reflects density, it does not indicate the periodic demand on the ADMARC stations, either for supplying inputs or for marketing. This latter demand is likely to be picked up in an indicator reflecting the amount of cropped land each station services. The assumption here is that where the ratio is low, farmers would be more likely to have better access, that is less waiting time, for inputs and to marketing.

INPUTDEN (2) = Density of Input Supply Points
= Cropped ha./ADMARC Facility
= 838

The above indicators, based on Table in Table V-4 give a good approximation of the number of farm households and cropped area each ADMARC facility must service. As seen above, there is a wide range across the ADDs, some with relatively low ratios and others where ratios are quite high. While these two indicators do not directly indicate how far farmers have to travel to get inputs or to market their crops, they can serve as indicators of potential delivery and marketing delays, and in general the volume of use a facility will get at times of the year. It should be pointed out, however, that many, perhaps most, farmers do not use inputs provided through ADMARC, nor do they market all their output through ADMARC depots. In fact, very little is marketed through ADMARC, depending on farmer use of new varieties and input packages. Three trends are clear. More produce is being marketed through ADMARC, more farmers are getting access to credit and inputs and ADMARC centers are experiencing more time-consuming delays.

Table V-4. Density of ADMARC Distribution Facilities and Farmer Proximity to Markets

District	Number of ADMARC Facilities (Est.)[1]	Farm Households Per Facility	Cropped Hectares Per Facility	Proximity to ADMARC Markets < 2 Km	> 8 Km
				--- percent ---	
Karonga	95	272	279	41.6	6.9
Mzuzu	354	256	318	29	9.7
Kasungu	123	945	1,869	13.2	38.9
Salima	89	773	536	37.5	2.2
Lilongwe	136	1,215	1,557	12.6	18.4
Liwonde	214	1,077	867	14.5	20.6
Blantyr	195	975	698	15.0	38.5
Ngabu	68	781	1,078	16.4	6.1
MALAWI	1,274	788	838	17.6	23.4

[1] Because of the difficulty in determining location and nature of depots, the figures will remain an estimate, although a fairly accurate one. What the data can't reveal are the areas in which distribution of supply points is adequate, and this is reported to be the case in project areas.

Sources: ADMARC Market Code List, 1985/86; National Sample Survey of Agriculture, 1980/81.

The last two columns in Table V-4 get more directly at the issue of distance from an input and marketing facility. These data are drawn from farmers' responses to questions in 1980/81 National Sample Survey of Agriculture. Although there were more elaborate tabular breakdowns in the survey, the ones in Table V-4 show the extreme categories, "less than 2 km." and "more than 8 km." from an ADMARC facility. Again, the district-by-district differences are striking, but for Malawi as a whole,

close to a fourth of all farmers estimate that they live more than 8 km from a station. Conversely, the majority are within 8 km., a figure which would fall within the area Mosher (1966) defines as being convenient to most farmers. About 18 percent are less than 2 km. In some districts close to 40 percent of the farmers are less than 2 km, which would suggest a large percentage within easy walking distance. One of the longer-run agricultural goals of Malawi is to locate a station within 5 miles (approximately 8 km.) of all farmers, in which case the following indicator would measure progress toward that goal.

INPUTPROX = Proportion of Farmers 8 km or Less From ADMARC Depot/Station
= 76.6%

This does not indicate farmer proximity to local markets, to public transportation for shipping agricultural products, or access to local and on-farm transportation. It indicates proximity to marketing facilities for most major crops, and for obtaining farming inputs.

Postscript On Other Planned Input Indicators

Several indicators were planned which would measure demand for various new forms of inputs, farmers' relative access to these inputs, and the number of private and public outlets for supplying inputs. For several reasons it was not possible to construct indicators along these lines. It is difficult to estimate actual demand for improved seed, fertilizer and other chemical inputs, although Table V-2 was able to draw on data which provided some estimate of fertilizer demand for a few years. ADD reports suggest that Malawi would be overwhelmed with maize if more farmers could get credit, and thus access to improved seeds, chemicals, and fertilizer.

NSSA data show "lack of credit" as being one of the main reasons farmers give for not adopting these forms of inputs. Thus it is apparent that demand is not being met, but the proportion of unmet demand is not known. Data in Table V-2 show that approximately 20 percent of the demand for fertilizer is not being met, on average, over a five year period. Whether this is a realistic figure for fertilizer, let alone other inputs, is not known.

Farmers in Malawi are differentiated in terms of access to input supply, and "conditions" are imposed on them prior to getting access to inputs. First of all, they are subject to farmer club membership and certification by the field assistant at the local level that they have met the established preconditions for receiving credit/inputs. Theoretically, inputs are equally accessible to all farmers since all farmers are eligible for membership in clubs. In practice, however, modern inputs are utilized more regularly by larger farmers and there are some indications that farmers' clubs are "selective" as well. Since a disproportionate number of small farms are headed by women (close to 30 percent) they tend to be among those excluded. Some women are receiving credit and inputs through established groups, and efforts are underway to get more credit to women. One ADD report suggests that women will not get more access to credit unless the FHAs (farmer home assistants) who work with women learn more about the uses of credit, or cooperate more closely with the male credit assistants. One of the important research questions suggested by this case study concerns the dynamics operating at the rural level where clubs are formed, and the rules regarding inclusion and exclusion in clubs.

For all practical purposes, modern inputs are available only through ADMARC, a government parastatal. The chemicals available through private sector sources are negligible at this point in time. ADMARC is the sole source of inputs, and the only significant input diffusion agency. Admittedly, more ADMARC depots are being added or contemplated, but it was not possible to determine how many are added annually.

ON-FARM RESOURCES

The farmer's ability and capacity to utilize new technologies and perform a variety of recommended cultural practices varies in relation to several household and farm level factors: the amount of labor available to the farm household; its level of income, from whatever sources; farmers' levels of education or literacy; and farm size, as well as other farmers and farm characteristics. These factors tend to be interrelated, so the presence of one factor will quite likely indicate the presence of others. For example, it is shown later that farm size is directly related to income derived from both on-farm and off-farm sources, and ultimately to utilization of new forms of inputs. Nevertheless there are several indicators which can gauge the "allocative capacity" of farmers and the amount of resources that are available and can be expended on improved technology and practices. What is more difficult, however, is demonstrating, with a limited set of data, that variations in on-farm resources have a bearing on actual adoption of new technologies and practices. It is believed they do, if at times indirectly. Later data will establish a relationship between utilization of new inputs and farm size.

Labor Availability

Many farmers in Malawi, regardless of size, at one time or another hire additional labor to help with certain farm operations. Conversely, most farmers engage in some off-farm employment, either on larger farms or on estates. Women, though, are less likely to do either than men, in large part because they have relatively small farms and already have high labor-

to-land ratios, thus obviating the need for additional labor. Because of participation in off-farm employment, and the incidence of single-adult households and households with few children in the working ages, many farmers simply cannot expand their cultivated area, even where additional suitable land is available. Current estimates place the level of arable land being cultivated at between 70 and 90 percent, and production on new lands is being discouraged. As a result, there are not the same opportunities for the labor surplus households to expand their cultivated area as in many African countries.

Widespread labor shortages, especially during critical periods, are a problem across Africa. In addition to the normal periodic labor bottlenecks, many of the recommended cultural practices, such as a second weeding and ridging are labor intensive. As a result farmers are faced with the prospect of hiring themselves out for cash and running the risk of not being able to perform the recommended practices, as well as delaying their own farming. Undoubtedly, many do work off-the-farm and as a result delay their farming or reduce the number of practices they adopt. Most small farmers cannot afford to hire labor.

There are two typically used indicators of labor availability on farms. One is household size, the other an actual measure of family labor:

<u>LABOR AVAILABLE</u> = Mean Household Size

= 4.5

OR = Mean Annual Family Labor (in Man/Day Equivalents)

= 2.8

Unfortunately, neither indicator is adequate for conveying just how much labor could be mobilized or recruited if land were available and economic returns warranted it. Moreover, there are not good measures for Malawi which indicate the annual labor requirements of a particular crop, although it is estimated that hybrid maize requires about twice as much labor as local maize.

The picture that emerges from the labor force data in Table V-5 is one of increasing labor availability on larger farms. Larger farms have more household members and consequently more available family labor on an annual basis. One would assume that this would bring some of the more labor-intensive cultural practices within reach of these farms. Larger farms also tend to hire somewhat more labor. The more dramatic evidence in Table II points out, however, that despite a high labor-to-land ratio (Column 5, Table II), there is relatively little off-farm employment among the very small farmers (0.5 ha) relative to the larger farms. In fact the data show that off-farm employment (in small rural businesses, or on other farms, and estates) tends to be fairly constant across the various size categories, suggesting limited off-farm employment opportunities in rural areas of Malawi. The data thus show, particularly for the very small farms, that there is excessive labor, and one might infer little opportunity for off-farm employment.

Table V-5. Household Size and Labor Data, by Farm Size

Farm Size	Average Household Size	Annual Labor Availability Family (Man/Day Equiv.)	Annual Labor Availability Hired (Man/Day Equiv.)	Average Workdays Off-Farm (Male and Female)	Labor-to-Land Ratio
Less Than .5 ha	3.7	380	6	126	10.0
.5 to .99 ha	4.4	467	14	130	3.2
1 to 1.49 ha	4.7	515	23	127	2.0
1.5 to 1.99 ha	5.3	612	32	119	1.4
2.0 to 2.49 ha	5.7	670	40	126	1.1
2.5 to 3 ha	5.7	724	36	99	
3 ha and Over	6.5	830	82	119	.9
National Average	4.5	498	20	127	4.0

Source of Data: Annual Agricultural Survey, 1982/83 (Unpublished)

The intent of the different forms of labor availability indicators presented above and in Table V-5 is to provide measures of labor at the disposal of the average farm household. One assumes that this average is related to a household's capacity for undertaking more labor-intensive practices, and to its capacity for generating a larger agricultural surplus. In addition, larger farms with a lower ratio of consumers to a given unit of land should have a greater capacity for innovating, especially with regard to risking fluctuations resulting from the experimentation implied in use of new technologies (Ashby, 1982). An alternative, and perhaps better indicator of labor availability, might be one expressed in the form of a labor-to-land ratio, which is essentially a

measure of the dependence of farm family members on a given unit of land. What is lacking though is a standard against which to judge whether the ratio is high or low. The assessments would have to be intra-societal and based on subunit (ADD) variations about the mean. In the case of Malawi, regional or size of farm comparisons could be made (e.g. Table V-5). A ratio higher than the mean would indicate a high proportion of labor per farm, and in the case of Malawi every size category is below the national mean. In part this ratio is high because of the many relatively small land holdings in the country.

Off-Farm Employment

Off-farm employment is thought to be related to the adoption of new technologies and inputs in diverse and opposite ways. First, off-farm work is viewed as a way of providing the income necessary for purchasing the inputs required for innovating. But, on the other hand, to the extent that off-farm work takes time away from farm activities or off-farm earnings dampen incentives to maximize farm income, it may lead to later adoption of new technologies or to non-adoption. What is evident in Table V-6 is that a majority of farmers (60.8 percent) have some off-farm wage employment, and the proportions do nor vary much from one ADD to another. Overall, about 15 percent of the farmers indicate that they have had employment on estates, suggesting that, by implication, much of the employment has been for other farmers or in non-farm employment. What cannot be determined from the above data is the extent of off-farm employment or the point in the planting/growing season when the off-farm employment takes place. Both are critical factors since they affect the amount of time available to a

farmer's own farm operation and to his/her utilization of labor required to innovate. Other data presented later show that slightly over 80 percent of farmer income is from farming, leading one to assume that off-farm employment is not extensive.

Table V-6. Off-Farm Employment and Household Income Data, by ADD

ADD	Household Heads With Any Wage Employment (%)	Household Heads With Employment Experience On Estates (%)	Household Heads With Same Primary Or More Schooling (%)	Annual Income Per Household (MK/Household)
Karonga	58.9	4.6	48.8	140
Mzuzu	65.3	8.9	49.4	136
Kasungu	65.9	18.3	40.8	210
Salima	60.2	9.4	30.2	121
Lilongwe	58.6	7.7	28.3	115
Liwonde	57.0	18.6	20.5	134
Blantyre	61.6	24.3	33.4	142
Ngabu	64.8	12.2	21.4	124
MALAWI	60.8	15.7	31.4	137

Education/Literacy

It is generally assumed that farmer education and/or literacy training are major prerequisites for innovation and utilization of agricultural knowledge, especially where new technologies and associated practices are complex. Higher levels of education are related to innovation on the part of farmers by virtue of its helping develop their capacity to search for more information, make better choice among inputs, combine inputs more effectively, judge appropriate quantities better, and in general endow them with a higher "allocative ability", that is, an ability to adjust to changes (Feder, 1951:17). In addition, education is believed to stimulate

farmer aspirations and attitudes which are conducive to change (Mellor, 1966). In light of the presumably low educational and literacy levels among Malawi farmers, input recommendations have tended to be of a "blanket" nature, and fertilizers have tended to be simpler and more amendable to application. What farmers are lacking in terms of a formal education background is being made up through nonformal education -- training courses, group extension activities, and repetition of simple invariant messages.

In Malawi censuses, formal literacy is defined as completion of standard IV, which is four years of elementary schooling. In the 1977 Census of Population this was established to be 31 percent for males and 15 percent for females. Undoubtedly, these proportions have increased with further expansion of education among the young. Employing a slightly different criterion here, a a more "liberal" one as well, Table V-6 establishes literacy at approximately 31.4 percent for farm household heads. It uses "any" primary schooling rather than at "least four years" to define farmer education/literacy. This figure is identical with that of the total population reported 3-4 years earlier. At a minimum it would suggest that rural and urban literacy levels are not far apart. The indicator for farmer education/literacy is as follows:

<u>EDUCATION</u> = Percent of Farm Household with at least some primary schooling

= 31.4%

Income and Farm Size

One of the universally recognized constraints to adoption of new technologies is limited financial resources, and lack of credit. Use of new forms of inputs requires that farmers have additional resources at their disposal and that farmers save and invest a portion of their earnings in new technologies. Although some informants suggest that farmers have money at their disposal but aren't willing to make it "public" by investing in their farms, it is believed by extension and others that credit, which puts more resources into farmer's hands, is the necessary requirement for agricultural development. It is expected that as farm income improves, farmers will be motivated to innovate further, and as farmer clubs build up their own credit funds, government and donor project efforts will necessarily shift toward other farmers, reducing the amount of overall credit.

There are two indicators which provide a measure of farmer resources, their income and farm size. Income is a direct measure, while size of farm tends to be surrogate for a larger number of potentially important factors such as access to credit, the capacity to bear risk, access to scarce inputs, wealth, access to information, and so on. Small farms also can impede the efficient utilization of certain types of technology. The indicators proposed are:

INCOME = Average Farm Household Income Level

= 137 Kwacha

Size = Average Size Holding

= 1.17 ha/Household

Income data are difficult to obtain from farmers, either because of reluctance to report actual amounts or their inability to do so. The figure reported above tends to be low when compared with recent World Bank data, $210 per capita in 1983. Likewise, the average size of holding is low, and also getting lower as a result of population pressure on the land, but again this average is heavily influenced by the nearly 60 percent of farmers with less than one hectare.

AGRICULTURAL SYSTEM INCENTIVES

Thus far the discussion of utilization has focused on availability of knowledge and familiarity with new technologies and practices, input supply, and the farm household's resource base and allocative skills. The farmer's decision-making environment includes also a variety of more macro-level factors which can act, to varying degrees, as incentives or disincentives to technology utilization and increased agricultural production. Factors such as prices of inputs and outputs, availability of credit, access to markets, transportation, storage, and other infrastructural alterations provide a set of "signals" to farmers. These signals can, directly, or indirectly, reduce farmers' perceptions of uncertainty and risk, as well as more directly remove some of the underlying constraints to adoption of new technologies and increased production. Although it is easy to talk about "critical" or "key" factors, generally complementary incentives are required. While access to credit may be important, access to inputs and markets are also undoubtedly important and perhaps are prerequisites to effective utilization of credit.

At the same time, however, the farm population must have a predisposition toward innovating and an acceptance of, at least in principle, the prospect of having to change production techniques. On this latter point, it was underscored time and again by key informants that Malawi farmers are favorably disposed toward use of new technologies, if only credit were available, fertilizer and seed demands could be met, prices were higher, and so forth. Later it will be shown with data from the survey of agriculture that lack of credit/cash was one of the main reasons farmers gave for not undertaking certain innovations and recommended practices.

The data will also show that farmers were unfamiliar with certain practices, did not have the time or labor to perform certain of them, or simply felt that some recommended cultural practices were unnecessary. The implication of these apparently conflicting constraints is that adoption of new technologies involves a circular complex of factors ranging from farmer training and extension to provision of inputs and resources, to incentives. Extension is vitally important in familiarizing farmers with and supervising their use of new forms of inputs and practices; research is required in order to demonstrate what practices, levels of inputs use, and combinations thereof are profitable. Finally, the broader decision-making environment, consisting of a broad range of institutional, legal, and infrastructural forces must be conducive to farm-level changes.

The following sections will attempt to provide several indicators which assess changes in three broad areas often viewed as stimuli to production: product prices, credit availability, and roads. There will

also be a brief discussion of on-farm storage, although little is known about it. The earlier discussions on input supply and marketing are, appropriately, system incentives as well but will not be reintroduced for discussion purposes here.

Prices

Two aspects of output prices are important to influencing farmers to adopt new technologies and recommended practices, price uncertainty and the relationship between input and output prices. Where farmers assume entirely the risk resulting from price fluctuations, or where input prices are increasing faster relative to output prices, the probability of adopting new technologies decreases. In Malawi, prices that will be paid by ADMARC are announced prior to each planing season, and over the years prices have generally increased faster than the costs of major inputs (Table V-7). The operating assumption has been that farmers are economically motivated and thus responsive to prices and inputs costs. Recent increases in maize production resulting from recent price increases are used as evidence to reinforce this view of farmers.

Table V-7. Output Price Changes, 1978/85

Commodity	Percent Change 1977/78 to 1984/85 (in Timbala/Kg)*	Average Annual Percent Change**
Maize	144	16
Cotton:		
Grade A	109	12.1
Grade B	78	8.7
Groundnuts:		
Chalimbana GDA	250	27.8
Chalimbana GDX	57	7.4
Manipintar and Malimba (shelled)	150	16.7
Malimba (unshelled)	155	17.2
Paddy Rice:		
Grade I	70	7.8
Sunflower:		
Grey Striped	22	2.4
White	43	4.8
Black	25	2.8
Beans:		
White Haricot	233	25.9
White Kidney	233	25.9
Canadian Wonder	264	29.3
Cassava	33	3.7
Wheat	173	19.2
Sorghum	140	15.6
Millet	550	61.1

* Increases in excess of 95.2 percent have increased in real terms.
** Increases in excess of 13.6 percent have increased in real terms.

Trends in fertilizer prices for the period 1977-78 through 1985-86 are presented in Table V-8. The 1985-86 prices are those announced for the forthcoming season. These are the three most widely used fertilizers by smallholders, and are applied to rice, maize, certain tobacco varieties, fruits and tea. Prices (in Malawi Kwacha per 50 kg. bag) show uneven

change over the nine-year period; a period of relative stability is followed by sizeable increases. In order to get a picture of what has occurred over time an average annual percent change was calculated for each fertilizer type. On this basis, fertilizer prices are seen to have increased from 15 to 24 percent/year, depending on type. In all three cases, however, the biggest increases have taken place over the last two years. The last row of Table V-8 presents percent change figures for the 1977-78 to 1984-85 period to permit comparison with the output price changes shown in Table V-7. The lower average annual percentage figures in this column reflects the large increases in fertilizer prices for the 1985-86 growing season now underway.

Table V-8. Smallholder Fertilizer Prices, 1977/78 to 1985/86

Year	Fertilizer		
	A/S 21% N	C.A.N. 26% N	20:20:0
	--- (Mk per 50 kg.) ---		
1977/78	5.50	7.75	8.50
1978/79	5.50	7.75	8.50
1979/80	5.50	7.75	8.50
1980/81	6.50	10.54	8.50
1981/82	9.00	10.54	8.50
1982/83	10.50	13.00	12.60
1983/84	12.00	14.00	14.50
1984/85	13.50	15.50	17.50
1985/86	17.50	19.00	20.50
Average Annual Percent Change:	24.2	16.1	15.7
1977/78 to 1984/85	18.2	9.7	13.2

Source: M. Mtika and K. m. Mtawali, "Fertilizer Marketing Costs Survey in Malawi." (Unpublished paper, December 1984).

The other side of the equation examines output price changes paid by ADMARC. These are shown in Table V-7, which lists percent change over the period covered and an annualized figure. The data show that for most commodities, prices have increased in real terms, and more than fertilizer prices over the period. Three indicators are proposed to reflect fertilizer prices.

FERTILIZER PRICES = Annual Percent Change, by Major Type (1977-78 to 1984-85)

= 18.2% Sulphate of Ammonia

= 9.7% Calcium Ammonium Nitrate

= 13.2%, 20:20:0

Indicators of output prices for maize and two varieties of groundnuts are:

OUTPUT PRICES = Annual Percent Change, Major Commodities (1977-78 to 1984-85)

= 16% Maize

= 27.8% Chalimbana GDA Groundnuts

= 7.4% Chalimbana GD%

In order to get a crude measure of the ratio of maize prices to fertilizer costs over this period, it can be seen that the average percent change in C.A.N., which is recommended for hybrid maize, is 9.7 compared to an annual 16% increase in maize prices. Thus a ratio of maize prices to fertilizer cost would be:

PRICE/COST RATIO (MAIZE) = 16/9.7

= 1.6:1

Credit

Lack of credit is an important limiting factor in the adoption of new technologies. Improved technologies are generally purchased off the farm, with the result that farmers are drawn into the market economy and their case needs are increased (Mellor; 1966:290). However, farmers have differential access to the capital required for adoption, with larger, more commercial farmers generally having greater access to resources and credit. Some data exist to show that a sizeable percent (46 percent) of Malawi farmers pay for some portion of the costs of inputs out of savings, but for the most part they are dependent on credit. A primary thrust of agricultural development efforts in Malawi has been the provision of credit, in kind, payable through farmers groups which assume responsibility for repayment. The need for credit is inferred in responses to questions in the agricultural surveys asking reasons for nonadoption, from the actual level of demand for credit, and from the additional cash costs involved in utilizing the inputs and technologies being promoted by extension and farmer groups and clubs.

Table II-16 (policy chapter) presents data on volume of credit, by ADD level and for Malawi, for the period 1977-78 through 1984-85. Over this period there has been a sharp increase, amounting to an average annual 63 percent increase, or 504 percent over the entire period. District changes, however, vary considerably, from a rather small 25 percent in Ngabu, which is presently without external project funding, to a more than 2,500 percent change in Blantyre ADD. However large as the percentage changes are, they represent on a per capita basis relatively little credit per rural farmer

or farm household. In 1980/81, the last year of a national agricultural census, credit amounted to 1.14 Kwacha/farm person, or approximately five Kwachas/farm household. Assuming 2.7 annual population growth over the past few years, the average amount of credit per farm household changes to approximately 12.6 K per farm household in 1984-85.

By any standard, this is a relatively low level of credit, but as was pointed out above, the changes are positive and sizeable. Credit, though, is not available to more than a small segment of the farm population, perhaps 10-15 percent. In Lilongwe ADD, for a specific example, a little over a fourth of the farm families is getting credit. This represents a 21 percent increase in number of borrowers over the last seven years. At the same time, however, the average amount loaned increased by almost 300 percent, from 30 MK to 89 MK. Ngabu, an ADD operating since 1983-84 on revenue funds, 20 percent of the farm households are receiving credit, at an average loan of 28 MK, substantially under what Lilongwe ADD farmers get. Finally, in Mzuzu ADD, in 1984-85 available credit was only 36 percent of demand, a figure far from adequate even after the ADD borrowed 30,000 MK from another ADD. About 25 percent of all farm families received credit, primarily for maize and tobacco. The available evidence thus seems to suggest that a small portion of farmers are receiving credit, the loan amounts are highly variable, availability of credit at the ADD level is contingent on external RDP funding, and credit is biased toward selected export crops. The following credit indicators have been developed.

CREDIT = Annual Percent Change in Credit Available (7 years)
= 63 percent

or

CREDIT = Average Amount of Credit/Farm Resident, Malawi
= 2.81 MK

or

CREDIT = Amount of Credit/Farm Houschold, Malawi
= 12.6 MK

Roads

Improvements in transportation, especially all-weather roads, have a direct effect on agriculture by giving farmers better access to marketing and input supply, and by giving extension assistants more mobility over longer periods of the year. Indirectly, better transportation facilitates movement of agricultural products off-the-farm and out of the countryside, gives farmers better access to off-farm employment and makes rural living more attractive in general. Most roads in Malawi are basically dry-weather tracks; many become unusable for different lengths of time during the cropping season. Even during the dry season when roads are in the best condition, extensive maintenance is required and travel is slow on most of the earth roads.

Roads are not the sole means of transportation for agricultural products, but a primary one in Malawi. The volume of grain shipped by rail or water is unknown. Roads, and vehicle availability, have been blamed for late delivery of inputs to ADMARC facilities and for transport of grain from these facilities. This is an especially critical problem since many ADMARC depots have inadequate storage and the produce is exposed to weather and other risks. Table V-9 shows trends in road construction over the four recent years, 1980 to 1983 (see also Table II-9). The largest annual percent increase has been in the construction of gravel roads, 27 percent per year, but still only a little over 500 km. are graveled in the country. Changes in paved (bitumen) and earth roads show lesser gains. For all types of roads for the four year period, 1980-1983, the change has been 1.8 percent increase in km per year. To get some measure of changes in road

inventory the following indicators have been developed:

ROADS = km per 1,000 Rural Households

= 9.03

or

ROADS = Average Annual Percent Change in Added km

= 1.8%

or

ROADS = Average Annual km Bitumen Roads Added, Last Four Years

= 62.25 km

Table V-9. Inventory of Roads, by Type

Year	Kilometers of: Bitumen	Gravel	Earth	Total
1980	1,904	254	8,604	10,762
1981	1,940	249	8,575	10,765
1982	1,940	529	8,295	10,765
1983	2,165	529	8,847	11,541
Average Annual Percent Change	3.4	27	.7	1.8

Storage

As mentioned earlier, little is known about farmers' on-farm storage capacity, or that of ADMARC depots in rural areas. Visual inspection of several of the latter facilities showed much grain being stored outdoors, with all the attendant risks. Storage is an important problem, and not one with an easy answer. Better on-farm storage may reduce seasonal price

fluctuations, but it may also transfer storage activities "into naive hands" (Mellor, 1966:336). Improved storage may also reduce losses from weather and pests, allow more timely exporting, and so forth. But storage itself involves additional costs for the farmer in the form of additional supplies and facilities.

Over the past several years Malawi has been emphasizing improvements in on-farm storage capacity for subsistence crops, and in the 1980/81 survey of agriculture asked several questions pertaining to storage capacity and improvement. The results reveal that less than 7 percent of farmers have post-harvest storage facilities, and almost 80 percent utilize no post-harvest protection. At the same time, 68 percent of farmers reported some post harvest crop damage. It appears that there has been negligible adoption of recommended post-harvest practices, and that production increases could be captured from more intensive promotion of such practices.

ADOPTION/UTILIZATION OF NEW TECHNOLOGIES

As indicated earlier, utilization of new forms of inputs and cultural practices is conceptualized as the end-product of changes taking place within the broader agricultural research-transfer system. In this specific case study, adoption/utilization is viewed as being, at least indirectly, related to: the actual existence of new technologies and farmers' awareness of them; cost and availability of new forms of inputs; farmers' resource endowments; and a host of system incentives and disincentives which influence farmers' adoption behavior. In Malawi there is a pervasive conviction that, in general, there is a relatively low level of adoption of

new technologies in the forms of improved seed varieties, fertilizer and other chemicals, and of recommended complementary cultural practices. In view of the proportions of acreage in improved varieties, or the proportions of farmers growing hybrids and utilizing fertilizers, there is ample evidence to support this perspective. There is also other evidence which suggests that adoption has proceeded unevenly across ADDs, and even where adoption has occurred, yields still fall far below their potential.

Despite Malawi's overall success in increasing agricultural output in selected commodities, it is suggested that a sizeable portion of those increases are coming from additional land being brought into production and from the diversification occurring on estates. The evidence underlying such assertions is not strong, and in large part is based on inferences which stem from the fact that although hybrid varieties have been available for a decade, a majority of smallholders continue to use "local seeds", plant without fertilization, and not follow recommended practices. Moreover, yields have not been increasing, and on average are nowhere close to what they might be.

Not all of the responsibility for low adoption rates on new varieties, fertilizers and other chemicals, and cultural practices should be shouldered by smallholders. Because of ADMARC's transportation and storage problems, input availability has been a periodic and recurring problem. New hybrid maize varieties are not as acceptable to consumers, and marketing has occasionally been difficult and time-consuming with delays in payment. But probably most importantly, farmers have not had access to the resources required to utilize the new technologies, or have not seen the

technologies as fitting into their existing systems of farming. In these respects, the new technologies have not been appropriate; nor have there been "appropriate opportunities".

What makes higher levels of adoption of new knowledge and technologies imperative in the Malawi context is the impending shortage of cultivable land bought. This is being brought about by the relatively high population growth (2.7 to 3.0 percent), and to a lesser extent the expansion of estates and the bulk of the remaining land which could be put into production is in the north. The emphasis in Malawian agriculture will therefore increasingly be placed on improving the productivity of resources already in use and on developing substitute forms of inputs, rather than on encouraging expansion of land. Estimates place the amount of cultivable land currently in production at between 70 and 90 percent, but with a population growth rate of close to 3 percent per year, the remaining available land (estimated at 1.4 million ha.) could well be taken up in less than a generation. As a consequence of these man-land pressures, and the resulting increase in population density, there is a pressing need to improve yields on existing cropland.

The following sections, will first, sketch out several basic characteristics and trends in Malawi agriculture to serve as a context for understanding smallholder farming; second, there will be a presentation of the available evidence for the level of utilization of new technologies and improved practices; and third, there will be an examination of existing evidence on some of the correlates of utilization and on the yields associated with adoption of inputs and recommended practices.

Basic Features of Malawi Smallholder Agriculture

The following data are presented as a general background to understanding some of the analysis and interpretation of findings on utilization of new technologies:

1. The average Malawi farm is 1.17 ha, a 24 percent decrease from what it was in 1968/69.

2. More than half the farm households have less than the 1.25 ha which are estimated to be the required minimum for meeting subsistence needs.

3. Almost 30 percent of all farm households are headed by women, and over 40 percent of all farms of half ha. or less are operated by women.

4. Smallholder agriculture predominates in Malawi, accounting for approximately 80 percent of total agricultural production, and occupying 70 percent of total land area. Only about 18 percent of smallholder hectares are in cash crops.

5. Agriculture employs about 85 percent of the Malawi's labor force.

6. Since 1968/69 total cultivated area decreased by 2 percent, from 1.36 million ha. to 1.33 million ha.

7. A high birth rate, and return migration for external employment are increasing population density, which is 60-65 persons/km^2, up from 43 persons/km^2 in 1966. Already Malawi is one of the more densely populated countries in Africa.

Evidence of Adoption of New Technologies and Practices

Maize: Maize is an important staple in the Malawi diet, and in recent years has become an export cash crop. Recently, it has been national policy to increase maize production through utilization of improved seeds, application of fertilizer, pest control measures, and improved cultural practices. Farmers are being instructed to monocrop hybrids, in pure stand, apply fertilizer and adhere to the following cultural practices: early planting; correct plant population; ridging; and early and repeated weeding. More specific recommendations pertaining to each of these inputs

and practices is contained in the annual Guide to Agricultural Production in Malawi: 1984-85.

Despite the availability of several high-yielding hybrid and composite maize varieties, farmers' levels of adoption of these varieties has been described as "disappointing". Available data on utilization of improved varieties and improved cultural practices suggests a mixed rather than disappointing response. Table V-10 presents the adoption rates for a set of six inputs and practices that have been recommended and promoted by field assistants among maize growers. Adoption of hybrid maize has been low. In no Agricultural Development District are more than 10 percent of the maize plots planted in hybrids, and overall slightly over 3 percent of cropped area is in maize hybrids. In some ADDs one percent or less of maize plots are in maize hybrids and for Malawi 3.4 percent of all maize plots are planted in hybrids. Although planting in "pure stand" is recommended, a little less than three-fourths of the plots are according to recommendations. There is some evidence that land pressures are constraining planting in pure stand, and it may not be advisable for small farmers to plant in "pure stand".

Table V-10. Adoption of New Inputs and Improved Cultural Practices on Maize Plots

District (ADD)	Maize Plots in Hybrids	Maize Plots Planted in Pure Stand	Early Planting (Before Mid December)	Weeding More Than Once	Maize Plots Fertilized	Maize Plots With Second Fertilizer Application
	percent of maize plots					
Karonga	7.3	61.7	31.9	31.4	12.7	4.6
Mzuzu	5.8	74.1	50	51.9	45.6	8.2
Kasungu	1.0	94.1	80.9	34.7	33.8	10.4
Salima	9.7	85.5	74.1	37.7	24.9	4.7
Lilongwe	1.2	74.7	79.1	25.6	31.6	6.8
Liwonde	.6	71.3	84.5	39.9	23	9.6
Blantyre	3.1	62.6	89.8	48.8	21.2	.9
Ngabu	4.0	89.1	67.7	56.7	.5	0
MALAWI	3.4	73.0	79.1	39.6	26.3	4.6

It should be emphasized that while relatively few maize plots are currently planted in hybrids, in the previous agricultural survey, less than 15 years before, there was not even an entry for hybrid maize. So there has been a change, although a small one.

Overall, more than 90 percent of the farmers' maize plots are still planted in local varieties, and 69 percent of the farmers are using seed "retained from last year". On most other items in Table V-10, however, the levels of adoption are higher. Almost 80 percent of maize is planted "early", before mid-December. The exceptions are the two northernmost districts, but in this case the early planting data is not necessarily relevant. Other evidence suggests also that late-planting of hybrid maize

is a farmers strategy to control cob rot when the rains start later and are expected to last longer. Almost 40 percent of maize plots are weeded more than once, and a little over a fourth of all maize is fertilized. Very few farmers fertilize a second time - a recommendation for both hybrid and composite seed varieties. The 26.3 percent figure on maize plots which are fertilized, when compared with the high percentage of plots in local varieties (90 percent) would suggest that many farmers are applying fertilizer to composite maize varieties.

Groundnuts: The Ministry of Agriculture recommends and encourages adoption of six improved varieties of groundnuts, depending on their intended end-use and the area of the country. All varieties are available from ADMARC. In addition to using improved seeds, farmers are encouraged to follow certain practices to increase yields: early land preparation and planting (before mid-December); maximum plant densities and proper spacing; early and thorough weed control; use of chemicals to control diseases; plus several other practices relating to harvesting and storage.

Very little data exists on adoption of these recommendations. What does exist is presented in Table V-11. A majority of groundnut plots are planted with "improved seed", although other data show that 61 percent is carryover from the previous season. The recommendation guide is unclear on the advisability of this practice, although it is generally not recommended since seeds lose viability. Table V-11 also shows that a little over half of the groundnuts plots are planted before mid-December a date specifically recommended, and a fifth of the farmers perform early weeding. A closer look at the percentages by district shows, however, that the overall

average is drawn down by the low percentages in the northernmost Districts which, as mentioned earlier, are areas of later rains and planting. It could well be that the general recommendations on planting and weeding are not entirely appropriate for these districts, although the figures still suggest a picture of non-adoption of most practices. On the last two practices, proper plant densities and frequent weeding, the general picture is again one of non-adoption. The general reasons for non-adoption are discussed in the following section.

Table V-11. Adoption of Recommended Practices on Groundnut Plots

District (ADD)	Plots Planted With "Improved Seeds"	Early Planting (Before Mid-December)	Early Weeding (1-3 Weeks After Planting)	Proper Plant Density	Frequent Weeding (More Than Once)
	percent of groundnut plots				
Karonga	38.4	12.6	12.8	51.8	11.5
Mzuzu	58.2	21.8	14.2	31.1	19.4
Kasungu	84.8	48.2	16.2	56.3	15.2
Salima	78.9	45.2	28.5	71.6	20.2
Lilongwe	84.6	56.8	22.4	43.3	17.3
Liwonde	68.7	80.7	22	38.8	37.7
Blantyre	62.7	83.7	24.6	35.7	45
Ngabu	74.5	35.1	24.5	54.6	44.4
MALAWI	75.8	55.4	20.3	48.8	23.1

Farmers' Reasons for Non-Adoption

It is often as important to know why farmers fail to adopt as why they do. Farmers' reasons for not adopting can pinpoint constraints to increased agricultural production. It is difficult, however, to get a good understanding of farmers motivations and reasoning when it comes to their deciding on changing practices and utilizing new inputs. Often farmers do not know why they do or do not do something, for traditional agriculture is steeped in routines and "rules-of-thumb" which operate at what is often referred to as the "pre-attentive level". Equally likely is the tendency among farmers in surveys to cite reasons for non-adoption which focus on extension and government shortcomings in getting needed credit to them. This is especially the case where interviewers are extension and government employees and where there is reasonable hope that the interviewers might be able to influence government policies and programs.

Despite the difficulties involved in understanding farmers' reasoning, and with due consideration to them, some data does exist with which to probe some of the reasons for non-adoption of selected inputs and practices. Because of the way in which the data were tabulated and presented in the National Sample Survey of Agriculture: 1980/81, exact percentages for each reason cannot be calculated. In lieu of that, rankings are assigned to the reasons in order of their frequency of mention.

The first observation that can be made from data in Table V-12 is that reasons for non-adoption vary by type of input or practice. From

the farmer's perspective, fertilizer use and adoption of improved groundnut seed is constrained by unavailability or lack of money/credit, while pesticides are not used primarily because farmers lack awareness of their selection and use. On both maize and groundnuts the main reasons why recommended plant densities were not followed, among those not using recommended densities, was that farmers did not feel it was necessary to follow the recommendations. The last column, which sums the ranks for the purpose of simplifying the data by using a summary measure, shows the relative importance of the different reasons. In this particular case, the lower the sum, the more important is a given reason overall. Heading the list is farmers' belief that the input/practice was unnecessary, followed by lack of money/credit and unavailability of inputs. Without further data and research, it is not possible to determine whether farmers' perceptions that certain inputs/practices are not warranted are grounded or not. In specific cases the farmers may be justified in their judgement, or there may be a failure on the part of extension to demonstrate the effectiveness of certain inputs/practices. Beyond the farmer's judgments that certain practices/inputs are unnecessary, there seems to be some basis for arguing that credit/money and input availability are problems.

Table V-12. Rank in Importance of Reasons Farmers Cited for Not Utilizing Selected Inputs/Practices on Maize and Groundnuts

Reason	Non-Adoption of Fertilizer On Maize	Non-Adoption of Recommended Plant Density	Non-Adoption of Insecticides on Maize	Groundnuts: Non-Adoption of: Improved Seed	Recommended Plant Density	Sum of Rank
	ranking of reasons					
1. Felt to be unnecessary	2	1	3	2	1	9
2. Not aware of input/ practice	5	4	1	4	4	18
3. Shortage of Time/Labor	4	2	6	5	3	20
4. Insufficient Money/ Credit	1	5.5	2	1	5	14.5
5. Combination of Reasons	6	5.5	5	6	6	28.5
6. Inputs Not Available	3	3	4	3	2	15

Evidence for Effectiveness of Selected Inputs/Practices on Maize

Recommendations regarding use of inputs and practices should based on research, on yields as well as on the profitability of adoption. It is difficult to get access to either type of data in Malawi, although results from the Annual Agricultural Surveys cross-tabulate yields with different input uses and utilization of different cultural practices. The yield results in Table V-13 are rather convincing in showing that utilization of the various cultural practices does increase yields on the average. For example, a second weeding, under all four maize variations, substantially increases yields. In some cases the differences are not dramatic, and in a few the differences may be due to peculiar weather in a region. What is lacking is all of the data, however, is an understanding of the economics of utilizing the various practices/inputs. Given the cost of fertilizer, for example, are the yield differences reported in the last two rows of Table V-13 sufficiently large to warrant recommending that particular set of practices and fertilization?

Table V-13. Yields From Different Varieties of Maize Under Different Levels of Inputs and Recommended Cultural Practices

Practice/Input	Local Maize Pure Stand	Local Maize Interplanted	Composite Maize	Hybrid Maize
	kg. per hectare			
Planting Date				
Early	936	857	1,667	2,308
Late	608	785	1,666	1,646
Weeding				
Once	864	770	1,488	1,786
Twice	995	956	1,776	2,494
Fertilization				
None	1,011	NA	1,337	--
Once	1,770	1,219	1,577	2,137
Twice	1,666	1,656	2,095	2,675
Early Planting, One Weeding and Fertilization	1,550	1,156	1,357	1,781
Early Planting				
Once Weeded	873	778	1,461	1,855
Twice Weeded	1,005	950	1,790	2,573
Early Planting, Twice Weeded				
Once Fertilized	1,207	1,285	1,700	2,615
Twice Fertilized	1,733	1,544	2,111	2,767

Source: Unpublished data from Annual Survey of Agriculture, 1982/83

The data in Table V-14 show yield differences for maize and groundnuts, by type of seed, and for maize interplanted with groundnuts and pulses. What the table shows, beyond what was in Table V-13, are ADD variations, although there is no way of knowing the combination of inputs and practices producing these yields. Not unexpectedly, hybrid yields are higher, as are yields from using improved groundnut seed, although in this latter case the difference are relatively minor. That pattern of local seed having lower yields generally holds across districts, but there some

exceptions, where maize composites out-yield hybrids (Blantyre, Salima), or where yields from local maize nearly equal those from hybrids (Ngabu). With groundnut yields, in several cases there are but minor differences, and in the case of Karonga, local varieties have out-yielded improved seeds, at least for that particular year.

Table V-14. Average Yields, by Type of Maize and Groundnuts, and Maize Interplanted

District (ADD)	Maize (Pure Stand)			Groundnut Pure Stand		Maize with	
	Hybrid	Composite	Local	Improved	Local	Groundnuts	Pulses
	kg. per hectare						
Karonga	3,084	2,442	1,369	447	503	1,376	1,488
Mzuzu	2,776	1,988	1,079	373	314	676	1,301
Kasungu	2,856	2,217	1,322	469	446	581	1,528
Salima	1,556	1,723	1,307	543	394	1,262	691
Lilongwe	3,442	1,850	1,206	247	245	762	1,347
Liwonde	1,255	1,196	870	392	375	942	904
Blantyre	1,196	1,960	1,087	387	109	1,033	1,131
Ngabu	1,394	NR	1,273	155	44	NR	NR
MALAWI	3,020	1,960	1,119	363	352	923	1,202

What is obvious in this set of data is that from district to district, and perhaps from year-to-year, there is considerable yield instability. This is reflected also in ADD progress reports which show trends over time and go into more depth about local conditions. In Ngabu, for example, the most recent document (May, 1985) reports a fairly stable hectarage in maize over the past 10 years, but decreases in average yields and a decrease in percent of land in maize. Likewise, in Mzuzu the 1980/81 to 1983/84 report

notes a "steady decline in maize seed sales and fertilizer to each club and club member...", although some of that decline is attributable to club expansion. Nevertheless, it is not obvious to all farmers that hybrid yields are sufficiently greater, in light of higher input costs and additional labor requirements, to warrant expansion or in some cases continuation of hybrid maize production. Once again, the "blanket recommendations" may not serve the farmers well in all districts.

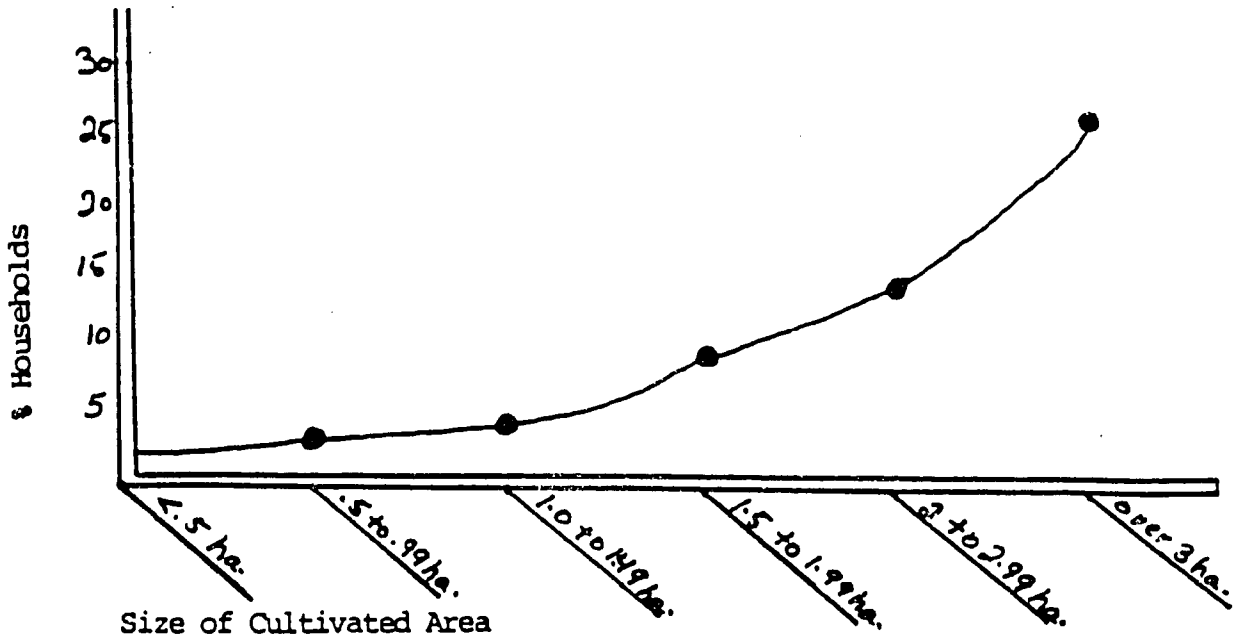
CORRELATES OF UTILIZATION

The agricultural practices and technologies available for use at any given point in time exceed the actual level of use among farmers. The size of this gap depends on numerous factors such as the nature of the innovations, socioeconomic conditions of potential adopters, needs of farmers, as well as the existing pool of knowledge for a given innovation.

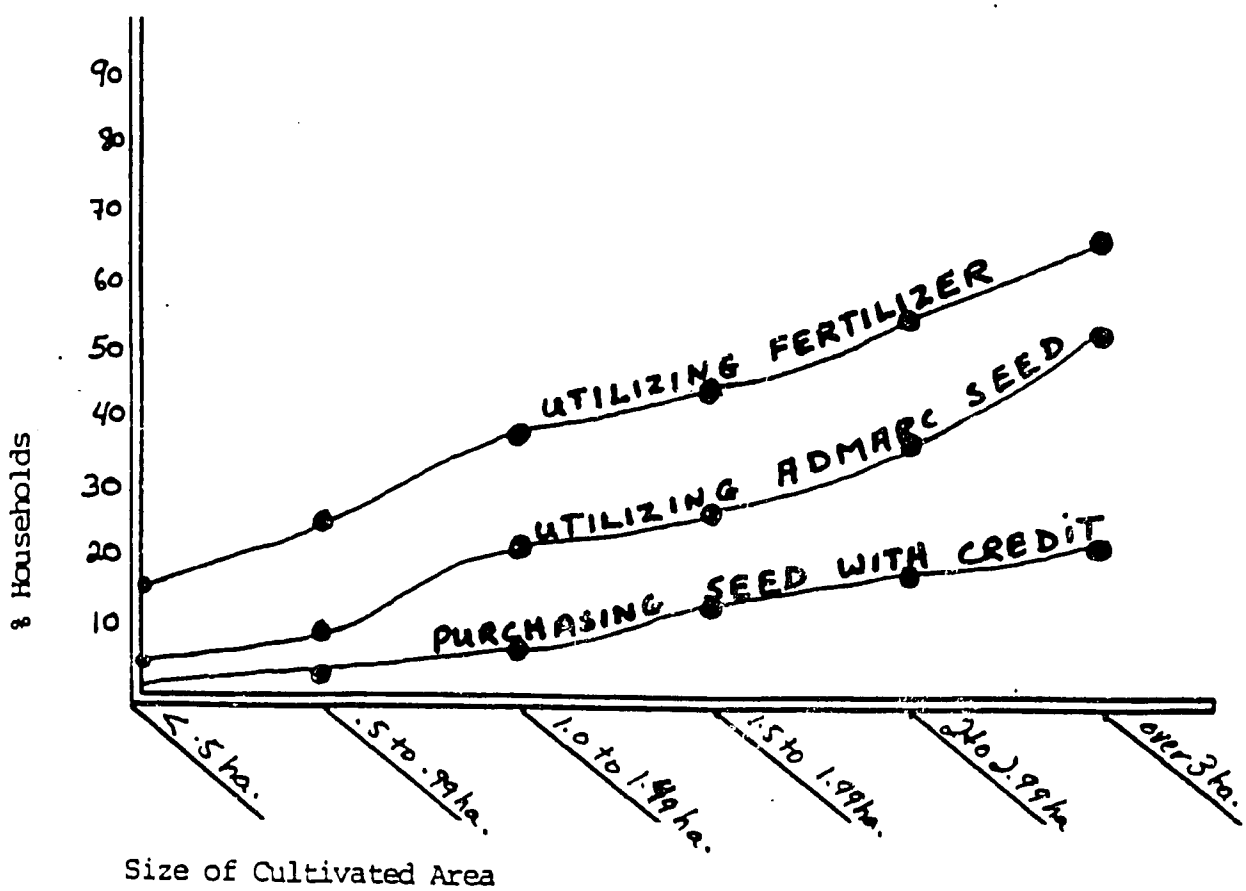
A substantial research base exists in the area of technology utilization to suggest that farmers' decisions to use new inputs and practices involve a variety of factors, individual as well as environmental or infra-structural. Farmers may be risk averters, illiterate or uneducated, lack access to labor and information, or have an inadequate farm size. However, they may also be faced with an uncertain supply of complementary inputs, inadequate transportation, marketing, uncertainties, lack of financial incentives, or insufficient credit with which to purchase new inputs and technologies. What complicates matters even more is that many of these factors tend to be "in motion", that is changing dramatically over time and affecting farmers' decisions in the process (Feder, Just, Zilberman, 1985).

Data previously presented in the discussion of the provision of inputs has examined some of the reasons farmers give for not adopting selected inputs and practices. Figure V-1 and V-2 present what data there is to show the relationship between certain types of input use and farm size, which is generally considered to be a surrogate for a larger number of potentially important factors. All four lines in the figures show a gradual upward change in level of adoption of inputs as farm size increases. Not surprisingly, more larger farms grow hybrid maize, use fertilizer, buy improved seed from ADMARC and obtain seeds on credit.

Percent of Households Growing Hybrid Maize by Size of Holding



Percent of Households Using Selected Inputs, by Size of Cultivated Area



251

As suggested above, farm size is correlated with other farm characteristics and on-farm resources, as shown below in Table V-15. First, there is a direct relationship between farm size and household size, and thus labor availability. Second, smaller farms are disproportionately headed by females; over 40 percent of one-half hectare and smaller farms are. Third, the very small farms with less than .5 ha. have almost half their annual income coming from off the farm, primarily from hiring themselves out to other farmers and to estates. In contrast, on the larger farms a large proportion of annual income comes from on-farm sources.

Table V-15. Characteristics of Farms, by Size of Farm

Farm Size	Distribution (%)	Average Household Size	Mean Annual Family Labor[1]	Female Heads (%)	Farm Income as Percent of Total Income[2]
Less Than .5 ha	27.8	3.7	1.69	42	55
.5 to .99 ha	31.9	4.4	1.99	34	73
1 to 1.49 ha	18.2	4.7	2.14	24	83
1.5 to 1.99 ha	10.7	5.3	2.44	17	88
2.0 to 2.99	10.4	5.7	2.65	10	94
3 ha and over	4.1	6.5	3.16	8	95
MALAWI	100	4.5	2.8	28	81

[1] In Man/Day Equivalents

[2] Total Income, Includes Off Farm Income and Remittances

Sources of Data: 1. Unpublished Annual Agricultural Survey data, 1982/83; 2. National Sample Survey of Agriculture 1980/81.

Adoption of new technologies is seen to be closely related to farm size and the factors associated with size, such as size of family, labor availability, income, and female head status. Many of these factors have an effect on yields, as seen in Table V-16. In every comparison, the yields from farms under one hectare are lower than for larger size farms.

Table V-16. Maize Yield, by Type of Maize and Size of Farm

Farm Size	Hybrid Maize	Composite	Local Maize	Total Maize
	--------- kg. per hectare --------			
Under .5 ha	1,222	1,470	976	970
.5 to .99	2,531	1,568	1,025	1,049
1.0 to 1.49	3,125	2,206	1,103	1,169
1.5 to 1.99	2,833	1,797	1,159	1,235
2.0 to 2.99	3,429	1,837	1,301	1,472
3 and Over	2,936	2,158	1,359	1,687
All Farms	2,988	1,920	1,119	1,202

SUMMARY

Any simple recommendation about major constraints to adoption/utilization of inputs and recommended practices is bound to be as useful as the "blanket recommendations" used by extension in its dealings with farmers. The evidence, and reports from various ADDs, suggest that neither credit, or any other single input above is going to get more farmers to use new seeds and more fertilizer. Moreover, there is no assurance of increased productivity. Constraints go beyond the availability of credit, as the district variations in hybrid yields would suggest. For many smaller farmers it appears that labor is a much more

critical factor, especially in the early part of the growing season and during harvesting. At the time when labor requirements are highest, farmers also have the best opportunity to hire themselves out for cash, and the greatest need to do so. Adopting new forms of inputs, and carrying out the cultural prerequisites adds additional labor burdens on the smaller farmers. Growing hybrids, planting pure stands, ridging, additional weeding, and just about every other recommended and "required" practice involves timely, additional labor. Whether infusion of additional credit to small farmers will address this problem is questionable. It goes without saying that labor mobilization and recruitment are two important social processes about which little is known in Malawi, or elsewhere in Africa for that matter.

FLOW THROUGH THE SYSTEM

Tracking Technology

The purpose of this chapter is to outline the channels by which technology flows through the system. The focus is on research generated (as opposed to indigenous) technology and the procedures by which technology is developed, tested, approved or released and then moves through the transfer system to farmers in Malawi.

Crop Improvement Technology can be grouped into three major categories: genetic technology (e.g. new crop varieties or hybrids), chemical technology (particularly pesticides) and cultural practices (e.g. fertility and planting recommendations, etc.). Each type of technology has been shown to follow somewhat different paths through the technology system to reach the farmer and each path will be described and discussed briefly. Following this overview of how each category of technology makes its way through the Malawian system, some examples will be discussed.

Genetic Technology

Most genetic technology originates outside the Malawi national research system, but there are some notable exceptions, such as the new disease resistant variety of fire-cured tobacco (DRV-7) and the new Chitembana variety of groundnuts that was developed in Malawi. Most genetic technology released in Malawi is either named varieties/hybrids, or selections from advanced lines that are introduced, tested and, possibly, reselected for Malawian conditions. For most food crops, Malawi regularly receives and screens international nursery trials that are prepared and sent out by international agricultural research centers (IARCs). These trials, which are received and planted by the Commodity Research Teams (CRTs), contain the most promising varieties and advanced lines that IARCs

have available from their own research programs and from their world-wide network of collaborating institutions. Some CRTs in Malawi also receive segregating materials from IARCs from which selections can be made and advanced lines developed.

Once a new variety or advanced line has been developed or introduced into the country, it must undergo at least three years of carefully testing at multiple locations in Malawi to determine its yield performance, disease/insect resistance or tolerance and appropriate cultural practices. Once the commodity research program leader is satisfied with the overall performance of a new line, a recommendation to release it is forwarded to the National Research Coordinator (NRC) for that commodity area (e.g. cereals) and then to the Deputy Chief Agricultural Research Officer-Programs and the Chief Agricultural Research Officer (CARO). If each of these individuals agrees that the new variety, hybrid or clone, is superior to existing material, it is then forwarded to the Varietal Release Committee (VRC) for consideration and possible approval. This committee generally meets in July each year and includes the Controller of Agricultural Service (CAS), the Chief Agricultural Officer (CAO), the CARO, the Program Managers from all 8 Agricultural Development Districts (PM-ADD), and representatives of the National Seed Company of Malawi (NSCM) and ADMARC. The VRC is the official body that releases new genetic material in Malawi and, after reviewing relevant research and trial data, generally makes one of three decisions: (1) release the new line as an approved variety/hybrid in Malawi, (2) reject the line as not being sufficiently better than current varieties to merit release, or (3) send the line back

for further testing and more data. The third outcome tends to be a frequent decision taken by the VRC. In fact, it was reported that some lines have been tested for up to eight years before being released. What generally speeds up the process is an urgent reason to release a new variety, such as a new disease outbreak.

Once a line is officially released as a named variety/hybrid in Malawi, the breeder seed is generally sent to the NSCM for multiplication, first as foundation seed and then as certified seed which is wholesaled to ADMARC under contract. ADMARC then retails the seed to farmers through its marketing depots. There are some notable exceptions to these latter steps in this process. For example, in the case of groundnuts, the NSCM maintains and multiplies the breeder seed to produce foundation seed; the foundation seed is then purchased by ADMARC and distributed to small farmers for multiplication as certified seed. ADMARC then buys back the "certified" seed from small farmers for distribution through its retail depots. ADMARC also handles the production and distribution of cotton seed for farmers.

The process of multiplying breeder, foundation and certified seed takes from two to five years. While seed is being multiplied for eventual distribution to farmers, information on this new varietal recommendation goes to the Extension Aids Branch for inclusion in the next annual production guide. Simultaneously in-service training and demonstration work begins among extension personnel. First, the new variety is tested at extension training centers, so that extension personnel can become familiar with the new variety and the recommended cultural practices. After a year

or two of direct extension worker experience with the new variety, it will then be demonstrated at the Extension Training Centers (ETC) and eventually on farmer's fields.

In addition to multiplying and selling seed through ADMARC, another important step in making new genetic technology more easily available to small farmers is to have the new variety included in a package that is approved for credit in each ADD. Without credit, few farmers can afford to purchase improved seed, such as hybrids, plus the necessary fertilizer and other inputs. Therefore, it is very important that the Program Manager in each ADD, where the variety can be successfully grown, approve the package for credit, so that more small farmers can have access to it.

The overall process of developing, testing, releasing, multiplying and disseminating new genetic technology is a lengthy process that can take as little as eight years or more than 20 years. Generally, most genetic technology would be available to farmers mid-way between these extremes. This process is summarized in Table VI-1 and Figure VI-1 which follow:

Figure VI-1

Flow of New Genetic Technology to Farmers in Malawi

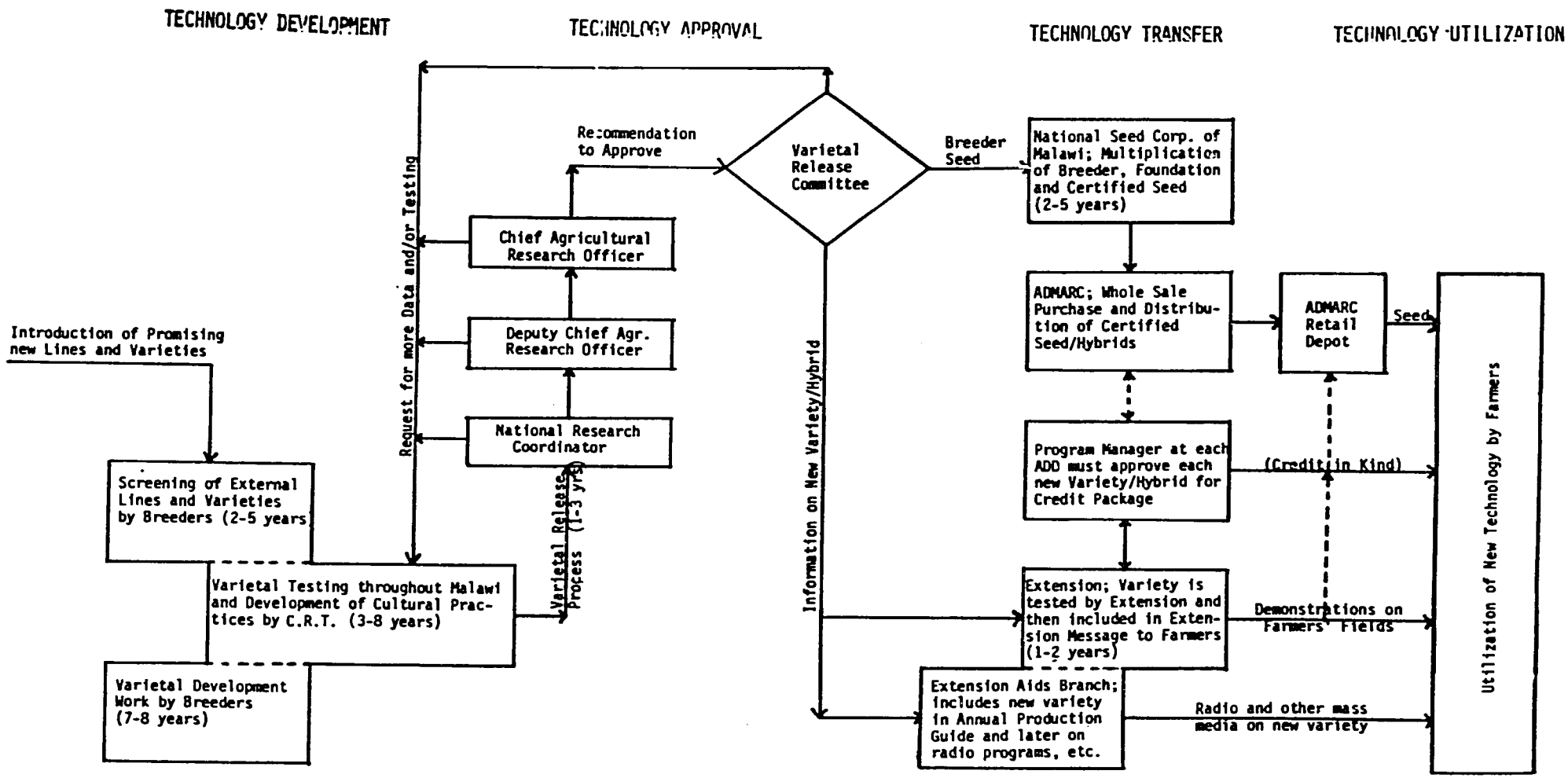


TABLE VI-1

PROCESS OF MAKING GENETIC TECHNOLOGY AVAILABLE TO FARMERS

1. Research and Development
   a) Varietal Development; 7-8 years of breeding work is required to produce a new variety
   a) Introduction and screening of promising lines/varieties from external sources, such as IARCs; 2-4 years of screening/selection work

2. Varietal Testing - Minimum of 3 years of replicated trials at multiple locations in the country; 4-8 years of testing is frequently necessary, because of requests for additional data in the varietal release process (see below).

3. Varietal Release Process - Each variety/hybrid must be approved by the commodity research team leader, national research coordinator and both the Deputy CARO and the CARO before being submitted to the Variety Release Committee for official approval (approval can occur the first year or additional testing may be required).

4. Varietal Multiplication and Dissemination Process

   Genetic material
   a) Seed is generally multiplied by NSCM, under contract to ADMARC, including: breeder seed, foundation seed, certified seed (2-5 year process).

   Information about New Variety:
   a) Varietal recommendation goes into annual production guide and other extension aids materials.
   b) ADMARC begins to market seed at retail depots (only limited quantity of seed may be available the first year).
   c) A.D.D. Program Manager(s) approves the new variety and concomitant inputs a package for credit.

   b) Extension personnel receive training and experience with the new variety at research stations and extension training centers (ETC).
   c) Extension personnel begin to demonstrate new variety to farmers, first at ETC and then on-farms.

Examples of New Varieties Released

Groundnuts

There are six improved groundnut varieties currently being recommended to farmers in Malawi. Each variety represents a different type of groundnut, or it is recommended for a particular agro-ecological zone in Malawi because of unique characteristics. The following table summarizes key information on these varieties, with respect to the source of each variety, when it was released and the extent of utilization by farmers.

Table VI-2

Groundnut Varieties Released in Malawi and Extent of Utilization

NAME AND TYPE	DATE RELEASED	SOURCE	CROP TARGET AREA	EXTENT OF UTILIZATION TARGET/AREA
1) Chalimbana Virginia-Confectionery	1958	Selection from Zambia	Plateau Area	100% of farmers
2) Chitembana Virginia-Confectionery	1980	Malawi - same phenotype as Chalimbana	Plateau Area	Not available; seed being multiplied
3) Malimba Spanish	1950	Gambia	Shire Valley (short season)	Variety grown by 100% of Shire Valley farmers
4) RG1 Virginia-Confectionery	1971	?	Rosette Resistant Variety for Thyolo Valley	10% of farmers In target area
5) Mawanga Virginia - 0.1	1980	Bolivia via USDA	Lake Shore	40% of farmers
6) Manipentar Virginia - 0.1	1973	Bolivia via USDA	Lake Shore	60% of farmers

According to the Director of the Groundnut Research Program, who is also the National Research Coordinator for Grain Legumes and Oil Seeds, the most significant genetic technology released since 1975 is Chitembana, released in 1980. However, to date farmers do not have access to this technology since the seed still is not available. The National Seed Corporation of Malawi (NSCM) maintains the breeder seed and multiplies the foundation seed for groundnuts. ADMARC contracts directly with small farmers to grow the certified seed. Apparently this system is not working well due to the difficulty of producing and storing seed with high

germination. Also, since Chalimbana (the older variety) and Chitembana (the new variety) are nearly identical phenotypically (Chitembana has a more desirable seed type), there is apparently a problem of the certified seed becoming adulterated. For example, farmers can increase the amount of seed they sell to ADMARC by adding some Chalimbana and getting the higher price for producing certified Chitembana seed. Apparently ADMARC lacks adequate seed inspection and quality control procedures to ensure that this doesn't happen. As a result, improved groundnut seed production appears to be a weak link in this dimension of the technology transfer system for groundnuts.

The availability of improved genetic technology for maize is quite interesting in that highly productive maize hybrids are available, yield potential of 3.5 to 4.5 tons/hectare on farmers' fields, but they are not widely used by farmers. In 1980/81 only 3.4% of maize plots were planted in hybrids. Additionally, three composites have been approved by the VRC for use by farmers (UCA and CCA are available in limited quantities, but Tuxpeno is not yet available), but availability of adequate seed from the NSCM continues to be a constraint. The yield potential of composites on farmer's fields is about 2.5 tons/hectare. Local varieties, on the other hand, are grown by 90% of the farmers, yet, average around 1.2 tons/hectare. Credit for both the seed and sufficient fertilizer was reported to be the major constraint to the increased use of hybrids . Also, most people prefer the traditional varieties, which are "flint" types, because they are easier to process in the home and produce a more highly desired flour (very white starch). Most hybrids are "dent" types

and are produced for sale to ADMARC and are considered to be essentially a cash crop.

An noteworthy development occurred two years ago when the NSCM tested, through the DAR, a new flint type maize hybrid developed by CIBA-GEIGY. This hybrid is well adapted to Southern Africa and is widely grown in South Africa. Given several years of test results in the region NSCM decided after one year of testing in Malawi to go ahead and sell the hybrid, since they were convinced it would be preferred by farmers. Because it had not been approved for release as a Malawi hybrid (MH), NSCM sold it under its own label as NSCM41.

Since there was a high level of interest in this hybrid by farmers, it was reluctantly approved for early release by the VRC even though it had not been tested for the required three years in Malawi. However, in 1985 the new hybrid was not readily available to farmers since ADMARC had not contracted with NSCM to produce seed and it cannot be approved by PM-ADD for credit sales for smallholders until it is handled by ADMARC. For example, during the 1984-85 season, only 250 metric tons of this seed were sold by private traders. In September, 1985 the NSCM had 900 tons of this new hybrid in storage. Since NSCM41 will not be handled by ADMARC again in 1985-86, the NSCM will probably export the surplus seed, even though there was reported to be high demand for that particular hybrid in Malawi, but limited access to it by small farmers for the hybrid in Malawi. This example demonstrates how the flow of technology can be constrained by the system itself, when one institution does not follow the established procedures, both in terms of testing requirements and in naming

the variety or hybrid, (i.e. NSCM41). This issue will be discussed further in the last section of this chapter.

Chemical Technology

The primary form of chemical technology used in Malawi is pesticides. Essentially all pesticides are developed by multi-national corporations located outside of Malawi and even outside of Africa. Some chemicals are manufactured in Africa, but essentially all have to be imported into Malawi.

The process by which farmers get access to new agricultural chemicals brought into the country follows two quite different patterns. First, there are actually few restrictions as to which agricultural chemicals may be imported into the country. Therefore, the estate sector has relatively easy access to new chemicals if there is a company representative in the country to import them, or if the estates are large enough to import the chemicals themselves. The factors determining which agricultural chemicals are used in the estate sector are essentially information and money. Farmers must know about the chemical and how to use it, and have the resources to purchase it.

In smallholder agriculture, and for most of the small estates as well, access to new agricultural chemicals is possible only after a lengthy testing program by the DAR and then eventual retail distribution through ADMARC stores. To be approved by the Ministry for sale through ADMARC, a pesticides must be tested for a minimum of three years to determine the yield response and economic benefit to farmers. To be approved, however, chemical companies must take the initiative for getting the material

tested. Therefore, in most cases, the chemical company provides the chemical to the DAR for three or more years of testing before a recommendation can be sent forward to the technical recommendations committee. In fact, the procedure which is outlined in Figure VI-2 below generally takes much longer.

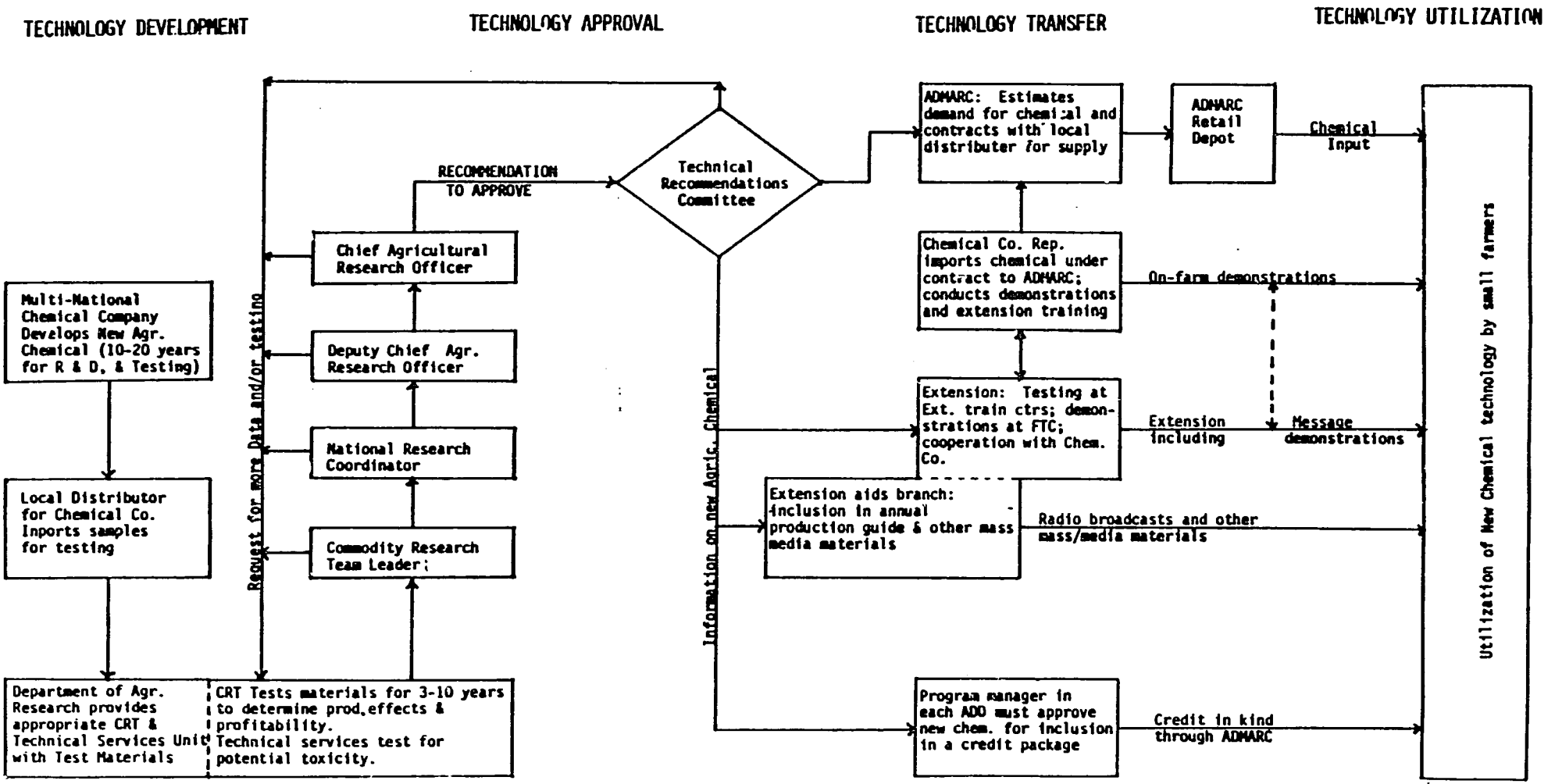
The procedure by which agricultural chemicals are approved by the Ministry and made available through ADMARC closely parallels that of genetic technology, except that it is approved by the technical recommendations committee (TRC), rather than the VRC. There appears to be at least one further difference that can greatly affect the approval process, and that is the attitude of the DAR and the Ministry toward agricultural chemicals. There appear to be two dimensions to this situation: ownership and negative perceptions.

In the case of genetic materials, the DAR actively screens new genetic materials that can be released as new varieties in Malawi. In most cases, the DAR assumes some degree of identification or "ownership" of the new variety. In the case of agricultural chemicals, however, these materials are clearly a company product and the DAR tends to take a more passive posture toward them. Therefore, rather than trying to actively screen all new chemical technology (in terms of economic benefits as well as potential toxicity), and to make the best materials available to farmers as soon as possible, the DAR moves slowly and cautiously.

The result can be a very long period of testing, with no built-in procedures to move the process forward in an expedious manner toward a decision (e.g. in three or four years). The problem apparently occurs

Figure VI-2

Flow of Chemical Technology to Farmers in Malawi



because the DAR and the researcher function in a largely regulatory, rather than a research role. Therefore, researchers receive no credit if the chemical is successful, but they will share the blame for approving a chemical if something goes wrong. The incentive then is for the DAR and the researcher is to test each chemical extensively to limit personal vulnerability.

The second more obvious problem is the negative public perception toward agricultural chemicals. Some pesticides are quite toxic and can result in long-term health and environmental hazards. Pesticide residue build-up is a problem that Malawi and other developing countries must guard against. However, since chemical companies are particularly sensitive and vulnerable to public criticism for polluting the environment, new generation chemicals tend to be much safer (to the user as well as to the environment) and more effective than the older materials. However, in many countries, including Malawi, the older generation materials are still being recommended and used, while the new materials are having difficulty getting through the system.

One example of the lengthy approval process is the use of the fungicide Daconil 2787 on groundnuts. Although groundnuts are a very important protein, oil and export crop for Malawi, grown chiefly by smallholders, their production has declined substantially over the past 15 years. In fact, ADMARC purchases of the crop declined from nearly 39,000 metric tons in 1972 to only about 13,000 metric tons in 1984. Actual production in 1982 and 1983 was only about 10-11,000 metric tons. As a result Malawi is rapidly losing its world-share of the confectionery nut

market, even though Malawi produces one of the best confectionery nuts in the world.

Some of this decline can be attributed to price policy toward groundnuts in relation to other crops, especially maize. However, the lack of disease control for the economically important fungal diseases is another serious and growing problem; one which is also influenced by price, since farmers have difficulty buying pesticides when the price of groundnuts is very low.

In DAR tests, Daconil has proven to be the most effective and economically beneficial pesticide available in Malawi for use on groundnuts. Yet, it was tested for nine years before being approved by the TRC, after which it had to be further tested by extension for two years before it could be demonstrated to smallholders.

Since 1980/81, the chemical company has run numerous training programs for extension personnel and through 1984/85 it had conducted 209 demonstrations on farmers' fields. Even after a decade of research trials, averaging a 68% yield increase, and two years of farmers trials, with an identical yield increase, utilization by farmers is very low. One important reason is that in one of the two primary groundnut producing ADDs, this pesticide is not approved for credit, making it effectively unavailable to small farmers. In the other main groundnut producing ADD, its use is once again spreading rapidly after some confusion in 1982/83 when farmers associated the fungicide with an unrelated drought induced attack of hilda bugs. Also, the chemical is approved for credit in that ADD.

A similar example of excessive delays in the approval process was found concerning a new generation insecticide that is very effective in controlling insects on cotton. Testing on this material started in 1975-76, but it was only approved in 1984-85 by the TRC for use in the 1985-86 season. Even though this chemical is widely used throughout Southeastern Africa (i.e. Tanzania, Zambia and Zimbabwe) and is recommended in every major cotton growing country in the World, it has been very slow to reach small farmers in Malawi. At the same time, small farmers in Malawi during 1985-86 will handle and use 345 metric tons of the toxic pesticide DDT (in combination with another insecticide), which is sold by ADMARC as the only pesticide available for controlling insects on cotton. Therefore, the new generation chemical, which is more effective and safer, also costs about 60% less, will be unavailable to small farmers for another year. But farmer pressure is growing since the new material is now widely used in the estate sector and the chemical company carried out 400 farmer demonstrations during the crop year 1984-85.

C. Cultural Practices

The need to develop and approve new cultural practices for a crop usually occurs when a new variety is released or when there is some other change, such as a new pesticide, in the technological package. For example, a change in varieties sets in motion a series of research trials to work out the necessary package of cultural practices that will enable farmers to exploit the genetic potential of the new variety to maximize production and, hopefully income. These cultural practices include

recommendations such as date of planting, plant population, depth of planting, and fertility and plant protection measures.

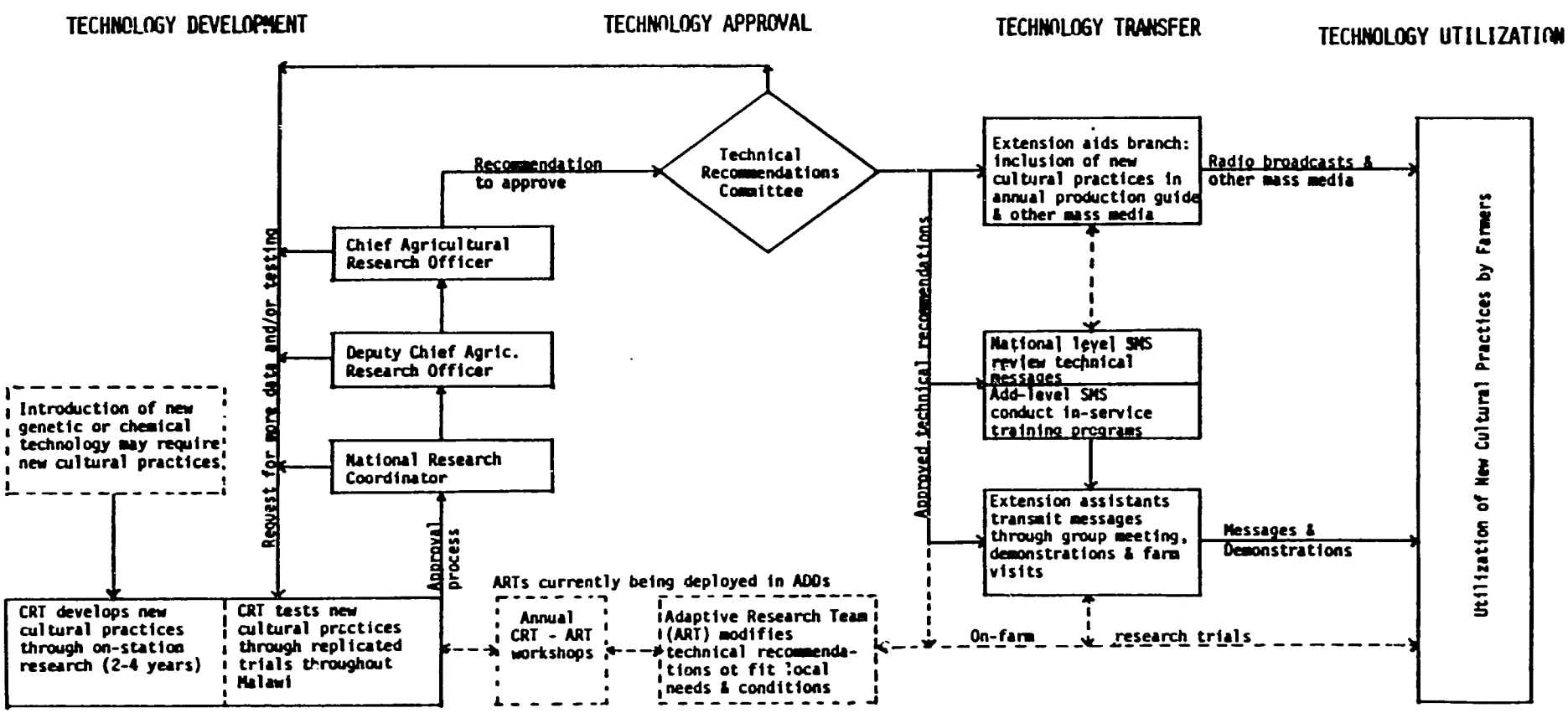
Once these practices have been generally worked out at the research station, they are tested for three or more years in replicated field trials throughout Malawi, or where the commodity is grown. When one or more cultural practices have been fully refined and tested by the commodity research team (CRT), the recommendation is then sent forward, through the NRC, the Deputy CARO and the CARO, to the Technical Recommendations Committee for official approval (see Figure VI-3). As is the case with both genetic and chemical technology, at each step in this process the recommendation can be sent back for further testing and additional data. Therefore, while three years of data is the minimum necessary to send the recommendation forward, unless the case is compelling and the need urgent, additional data may be required.

Once the cultural practice has been approved by the TRC, this new information moves through two channels of the transfer system. First, it is included in the annual production guide and released publicly through this channel. In addition, it moves through other mass media channels, particularly through printed materials and radio programs developed by the Extension Aids Branch. Finally, extension personnel receive training and experience with the new practice at the extension training centers, before it is demonstrated to farmers. Farmer demonstrations occur first at the extension training centers and later through on-farm demonstrations.

A second link in the technology transfer system is the transportation and retailing function of ADMARC for inputs such as fertilizers. Once the

Figure VI-3

Flow of New Cultural Practices to Farmers in Malawi



rains become heavy during the growing season, the unimproved roads become difficult or even impossible for shipping fertilizers and other inputs. There are frequent reports of inputs not being available in sufficient quantity when needed in many rural areas of Malawi. Part of the difficult is ADMARC's lack of capacity to anticipate effective demand and to get adequate supplies in place before the rains get too heavy. In addition, the disruption of external rail service for imported inputs has further complicated ADMARC's capacity to have sufficient agricultural inputs on hand before the growing season begins.

One final point to keep in mind about this process of testing, approving and disseminating new cultural practices is that this is a centralized system of developing "location specific" technology. Therefore, recommendations in the annual production guide and subsequent circulars, generally specify a range of treatments (e.g. 60-80kg of N and 30-40 kg of P/ha), since blanket recommendations will generally not be appropriate for the entire country.

At the same time, however, subject matter specialists (SMS) have little contact with researchers and, in the past, have not received research findings for their specific ADD which would permit them to refine the general recommendations and specify what practices farmers should actually carry out in each agro-ecological area of the ADD. The problem is further complicated in the case of purchased inputs (e.g. fertilizer) in that a "generalized" package is sold to farmers on credit by ADMARC, when, in fact, some modification of this generalized recommendation may be necessary for a particular ADD or agro-ecological zone within the ADD.

The current move to establish adaptive research teams (ARTs) in each ADD is a logical step to solve this problem and develop more location-specific recommendations for farmers. This change implies that technical recommendations, particularly with respect to cultural practices, will need to be made or at least modified, at the ADD level, rather than at the national level by the Technical Recommendations Committee. Or, over the short-run, until the ARTs develop sufficient competence and experience, perhaps this decision-making should be shared between the national and ADD levels. This might result in the national committee continuing to approve generalized recommendations from the commodity research teams, but with a comparable TRC at the ADD level to begin modifying these recommendations with respect to both extension messages and the technical packages being approved for credit. Eventually, most cultural practices should probably be refined and approved at the ADD level, with this information being shared at the national level, with other ADDs.

A more decentralized decision-making process will have major implications for how extension messages are packaged and disseminated. As recommendations become more location specific, it will be increasingly difficult to collect and package this information each year in the Annual Production Guide. Instead, more and more extension messages will need to be formulated, packaged and disseminated at the ADD level. This has direct implication for the technical competence and role of SMSs, and the capacity of the communications unit at the ADD level to insure the rapid processing and flow of location specific research findings to farmers.

Concluding Observations

The system through which new technology flows in Malawi might be characterized as a well organized, centralized system that is very conservative and cautious about approving recommendations. Because science is, by its very nature, conservative, the research system is not about to approve a new technology unless it is very sure the recommendations is low risk and economically beneficial to farmers. There is a real concern, however, that the system in Malawi may be too conservative and does not take full advantage of other available data (e.g. from neighboring countries) in the approval process, thus unnecessarily slowing the flow of new technology to small farmers.

Obviously this is a question of balance, but the Ministry (through the DAR, and the TRC and VRC) appears to control the process excessively in the name of protecting small farmers from "unproven" technology, rather than involving farmers in the process and sharing responsibility with them. In many respects the Ministry, through its centralized approval process, is in effect putting its own credibility on the line, when it approves and recommends a new technology.

In the case of new pesticides and new genetic materials that are beginning to flow out of the private sector, the system may have erred even farther on the side of caution, obstructing the flow of substantially improved technology to farmers. Where new technology is being successfully used in nearby countries, three years of local testing should be more than enough to approve its release in Malawi. Nine or ten years of testing before granting approval is putting Malawian farmers at a competitive

disadvantage with those in neighboring countries as they seek to cut costs and expand their respective markets. In most cases, if the research is carried out in a competent manner, a maximum of three or four years of testing should produce sufficient data for a new technical component or recommendation to be carefully evaluated.

An analysis of this dilemma suggests two important issues. The first involves how the DAR perceives its own research function, and a second involves the posture of the DAR with respect to private sector technology. Given the size of Malawi and its ability to support only a limited research capability, it is a reasonable policy decision, over the short run, to focus on applied and adaptive research, and on borrowing and utilizing externally developed technology. The entire organization and allocation of research resources in Malawi provides evidence that this policy decision is being followed.

The relationship that has emerged between DAR scientists and the international agricultural research centers (IARCs) is generally positive, since commodity researchers can screen and recommend advanced lines and new varieties for release that can be marketed as products of the local research system. The IARCs provide considerable latitude for national programs to capture much of the recognition for releasing new genetic technology in the country, including new material that was essentially developed externally.

The relationship between DAR researchers with private sector firms is quite different, however, since new technology is generally marketed under patented trade names to maintain the firm's proprietary interest in the

product and to ensure product recognition and marketability. The result is that the DAR serves essentially as a regulatory or approving agency, rather than in some type of joint research effort. Thus, as mentioned earlier, the DAR derives no direct benefit if the technology succeeds, because it lacks any real or implied ownership of the technology. While on the other hand, as the "approving" agency, it will partially share the blame if the technology proves dysfunctional. The result is that the DAR has an incentive to delay the approval process as long as possible to minimize its own risks.

The relationship between the DAR and the private sector must be carefully reconsidered. The private sector is becoming an active purveyor of the new technology in Malawi and other developing countries--technology that will increase the productivity of the agricultural sector and enable countries to become more nearly self-sufficient in terms of domestic food production. In the process, the private sector will put up the necessary investment capital for the Research and Development (R&D) effort and, because it is working in several nations in the region, it can spread the R&D costs and derive benefits from a much broader market area than a single national research system. The question is, can the DAR and the private sector form an acceptable partnership whereby the interests of both organizations can be served while pursuing the national objective of increasing agricultural production and the incomes of small farmers in Malawi?

CHAPTER VII

SUMMARY AND CONCLUSIONS

This first part of this chapter is a summary and discussion of the main indicators used in the INTERPAKS' analytical model of the technology development, transfer and feedback system in agriculture. The summary is followed by a conclusions section synthesizing the major findings and identifying the major strengths and constraints of the agricultural technology system in Malawi.

Policy Indicators

P1. Government's Commitment to Agricultural and Rural Development

Indicators:

A. Agricultural share of recurrent government expenditures (Revenue Account) = 4.9% for agricultural research and development (including extension); 10.4% for all agricultural expenditures, including crops, livestock, veterinary, fisheries, forestry and other natural resources; Trend: increasing at about 7.0% annually in real terms.

B. Agriculture's share of the government's development budget = 20.5% for the total agriculture sector, including crops, veterinary, fisheries and forestry; an additional 16.1% for road and bridge construction and maintenance.

C. Kilometer of Roads = 9.03 KM/1000 farm households; trend: increasing at 1.8% annually; major emphasis is on replacing earth/gravel roads with all weather (Bitumen) roads which are increasing at 8.1% annually.

Discussion:

The agriculture sector has contributed about 37% to the Gross Domestic Product (GDP) during the past five years. The agriculture sector is directly receiving about 10% of the recurrent government budget, with about one-half of this going directly for agriculture research and development, including extension, credit and land husbandry. The development account is largely donor-financed (89%) and the overall agriculture sector is directly receiving about 20.5% of these resources. In addition, another 16% of the

development budget is allocated to roads and bridges. The essential physical infrastructure which is very important to long term agricultural and rural development. The overall network of roads in Malawi is increasing very slowly; most work is directed to improving the quality of roads, particularly increasing the kilometers of all weather roads. In 1983, there were 2165.6 KM of Bitumen roads. Overall, it appears that government is committed to agricultural and rural development and is investing a substantial portion of national resources in the agriculture sector.

P2. Investment in Technology Development

Indicator:

Recurrent agricultural research expenditures/AGDP = 0.72% of AGDP in 1984; Trend: increasing at about 5.0%/year in real terms.

Discussion

It was estimated that in 1984, both public and private investments in agricultural research totaled about MK 5,138,990 or US$3,953,069. This amount was about 0.72% of agricultural gross domestic product (AGDP) during that year. During the period 1980-85, public sector agricultural research expenditures increased by about 5% annually in real terms. Given that AGDP increased at about 2.1% annually during this same period, agricultural research expenditures gained slightly (about 3.0%/year) in relation to AGDP.

It is generally recommended that a country should invest between 1-2% of AGDP in agricultural research. While Malawi is below this recommended minimum target, she is investing at a higher rate than most African countries, which average about 0.25% of AGDP. Furthermore, Malawi is

improving her position and essentially, all recurrent costs for agricultural research are funded out of the revenue account. Starting in 1985-86, two new projects funded by World Bank and USAID will help strengthen the physical and human infrastructure of the agricultural research system.

P3. Investment in Knowledge Transfer

Indicator:

Recurrent agricultural extension expenditures/AGDP = 2.2% of AGDP, or 2.8% of smallholder AGDP; trend = increasing at about 7.5%/year in real terms.

Discussion

Estimating annual agricultural extension expenditures was difficult for two reasons. First, agricultural extension or knowledge transfer is a primary function of the Department of Agriculture (DOA), but this unit also administers agricultural credit, land husbandry and other agricultural development programs. Therefore, the resources attributed to knowledge transfer were estimated, based on personnel assignments in the DOA. It was assumed that three-fourths of Agricultural Development Division (ADD) and DOA headquarters expenditures, plus 100% of Extension Aids Branch expenditures could be attributed to the knowledge transfer function in computing this indicator.

Second, some resources from the Development Account (i.e. donor financed capital expenditures, which are allocated to the Rural Development Projects (RDP), are actually used for recurrent (operating) expenditures of the agricultural development divisions (ADD). In fact, in 1982/83 about 42% of ADD recurrent expenditures were funded from the Development Account.

During that year, about K12.42 million was spent on agricultural development or about K9.5 million on knowledge transfer, or about 2.2% of AGDP.

During the period 1980-85, DOA expenditures (revenue account) were increasing at about 7.5%/year in real terms. Given that agricultural sector growth averaged about 2.1% during this period, it was estimated that knowledge transfer expenditures were increasing at about 5.5%/year in relation to AGDP. In addition, two new projects, financed by the World Bank and USAID began in 1985/86, which should further strengthen agricultural extension and the knowledge transfer function in general.

The primary area of concern, with respect to knowledge transfer expenditures, is the large proportion of ADD recurrent expenditures that are being financed from the Development Account. When the donor financed development cycle for each RDP in each of the eight ADD's has been completed, these recurrent costs will have to be absorbed and funded from the revenue account. This readjustment may result in a declining share of the revenue account expenditures devoted to program and operations. As will be discussed later, this trend already appears to be well established.

P4. Agricultural Inputs

Indicators:

A. Average amount of fertilizer used in Malawi (measured by kilograms (kg) of fertilizer per hectare (ha) of cropped land) = Smallholders: from 11.7 kg/ha in 1970 to 50.3 kg/ha in 1984/85 or an average 22% annual increase; Estate Holders: from 42.9 kg/ha in 1970 to 140.2 kg/ha in 1984/85, or a 15% average annual increase.

Discussion

The use of more modern agricultural inputs has risen steadily since independence. The use of fertilizer by smallholders was used as the indicator to measure the increased use of agricultural inputs. Over the period from 1970-1984, fertilizer usage has increased about 22% annually among smallholders. During this same period, estate farmers increased their fertilizer usage by 15%/year. Data were unavailable for other types of agricultural inputs, but several pesticides are recommended, especially for cash crops, and their use is also increasing. For example, in the two year period 1982/83 through 1984/85, the use of Sevin, DDT and D.I.N. increased at 100%, 90% and 72% annually, respectively. The National Seed Corporation of Malawi sells about 2000 tons of hybrid seed corn each year, but these sales have been relatively stable over the past few years.

P5. Availability and Use of Agricultural Credit

Indicators:

A. Agricultural credit used by smallholder/private sector credit = 3.2% of private sector credit (5 year average); TREND: agriculture's share is increasing and was up to about 6% of private sector credit in 1985.

B. Percent of Farm Households Using Credit = estimated at about 15% (1985); average size loan K 75.00 (1984/85).

C. Credit available/Farm Household = from about 4.4 kwacha/farm household (1980) to about K 12.60/farm household (1984/85), or about US $9.00/F.H.

Discussion:

Given the very low average farm household income level (K137/year), credit is crucial if smallholders are to have access to purchased inputs that are central to most improved productivity. All smallholder credit is now dispersed in-kind through farmer clubs. About 18.6% of all farm

households in Malawi are members of a farm club and the number is increasing at about 11% annually. Both the number of small farmers having access to credit, plus the average size of loan is increasing annually, however, even at the current rate of growth, it will be many years before a majority of smallholders will have access to credit and improved technology.

P6. Commodity Prices

Indicator:

A. Farm Gate Price/World Market Price of selected commodities; Maize = US$86/ton (farm gate) divided by $149/ton = 58%; Groundnuts = US$412/ton (farm gate) divided by $830/ton = 50%. In both cases, 1984 farmgate price/1983 average world market price were used in computing these averages.

Discussion

The Agricultural Development and Marketing Corporation (ADMARC) purchases all smallholder crops and handles their export whenever possible. Buying expenses, transportation, storage and related costs represent about 32% of the total cost of purchasing and marketing (including both domestic sales and exports) agricultural crops. In 1984, ADMARC realized a 12.8% profit on total sales; however, nearly all profits were realized on the export of tobacco, which helped offset minor losses on the purchase of certain other crops.

Price policy in Malawi appears to one of establishing comparable prices across commodities, with respect to returns to land and labor. Smallholders in Malawi appear to be quite price sensitive and will shift land between commodities based on announced pan-national prices. This fact appears to account for the substantial strategic reserve of maize that has

built up since 1982/83, while groundnut production is down sharply.

P7. Growth in Agricultural Gross Domestic Product (AGDP)

Indicator:

A. Annual Growth in AGDP: 1973 - 1979 = 5.3%/year in real terms; 1980 - 1985 = 2.1%/year in real terms

Discussion

The agricultural sector has grown steadily since independence, with the exception of 1979-82 when a combination of factors, including weather and price policy resulted in -0.9% negative growth. Over the past two decades, the estate sector has accounted for more of the actual growth in the agricultural sector than from the smallholder sector.

P8. Agricultural Exports

Indicators:

A. Agricultural Exports/Total Exports = 90+%

B. Annual Increase in Value of Agricultural Exports = 2% annual increase in real terms; 19% annual increase in current kwachs (5 year averages)

Discussion

Agricultural Exports heavily dominate Malawi's domestic exports. Tobacco (49%), Tea (19%) and sugar (14%) are the primary crops that contribute to export trade. It is estimated that 80% of export crop production is produced on estates, although smallholder production of tobacco has increased in recent years. The export of groundnuts, the second most important export crop grown by smallholders, declined to only about 1,300 tons in 1984, representing only about 0.5% of all agricultural exports.

P9. Food Imports

Indicator:

A. Value of Food Imported/AGDP = 5% (3 year average through 1982)

Discussion

Malawi is essentially self sufficient in terms of its own food requirements. She does import some dairy products, vegetable oils and wheat products which account for most of the food imports. In recent years, Malawi has received very little concessionary food imports, but has been a supplier of concessionary food to neighboring countries through purchases by donor aid agencies, such as IFAD.

Technology Development

TD1. Investment in Agricultural Research

Indicators:

A. Financial Resources invested in agricultural research = recurrent costs as a percentage of AGDP = 0.72% of AGDP

B. Growth in Financial Resources (real terms) = 5% increase/year

Discussion: see discussion under P2

TD2. Allocation of Financial Resources

Indicators:

A. Financial Resources for Research Programs and Operations = percent of recurrent expenditures allocated to program and operations = 43.3%

B. Commodity research programs receiving fewer financial resources than their contribution to AGDP [i.e. research budget (%) allocated to each commodity, divided by their respective contribution (%) to the AGDP] = Maize (30%), roots and tubers (30%), groundnuts (70%), tobacco (80%) and fruits and vegetables (80%).

Discussion

A common problem in many developing nations is that research organizations allocate too much of their research budget to salaries and personal emoluments, and too few resources are left for research programs and operations. The reasons for this pattern are understandable. For example, some governments attempt to hire all of their university graduates and, unless the overall research budget expands accordingly, these salary costs soon overtake program expenditures. In addition, there is always pressure to keep scientist salaries competitive, so that scientists continue their employment with the research organization.

There are no recommended figures in the literature to indicate what is a desirable balance between expenditures for program and operations, compared with salaries and personal emoluments. It is expected that in a functional system, however, there should be a nearly equal balance between program expenses and salaries. Furthermore, based on experience elsewhere, a 6-7% capital expenditure line for maintenance of physical facilities and equipment appears appropriate. Therefore, from experience elsewhere, the anticipated parameter for program and operational expenses is expected to be around 45-47% of recurrent costs. Malawi is currently averaging around 43% which appears to be a little low, particularly for an applied-adaptive research program that would have high transport costs for off-station research trials.

The allocation of resources to different commodity research programs appears generally good, however, maize, roots and tubers may be receiving too few resources in relation to their relative contribution to AGDP.

Since it is possible to "borrow" genetic technology from the private sector for maize (i.e. hybrids, such as NSCM-41), perhaps the current allocation to maize research is sufficient. However, roots and tuber research appears to need more attention, if the productivity level of these crops is to be increased through research.

The allocation of resources to tobacco research appears, on the surface, to be nearly adequate. However, trends over the past two-three years suggest that the situation is deteriorating. Given the decline in resources for tobacco research, in real terms, over the past two to three year period, and the increasing value of tobacco to the agricultural economy of Malawi, it was determined that only about 0.3% of gross tobacco revenues were being reinvested in tobacco research in 1984/85. Since Malawi has substantially reduced its formal research linkages with Zimbabwe, she must maintain an adequate level of research investment to sustain the technology needs of the tobacco industry. The current trend suggests serious long term problems.

TD3. Human Resources for Agricultural Research

Indicators

A. Number of Scientists/U.S. million dollars of AGDP= 0.28 scientists/U.S. million dollars of AGDP (including expatriates in established posts), or 0.23 national scientists/U.S. million dollars of AGDP.

B. Proportion of scientists holding post-graduate qualifications (M.Sc. degree or higher) = 45%

C. Technician to scientists ratio = 2.5:1 (if technical assistants are included)

Discussion

The number of scientists (B.Sc. degree or higher)/U.S. million dollars of AGDP is another indicator of national investment in agricultural research. In Africa, a 1% of AGDP investment equals about 0.39 scientists/U.S. million dollars of AGDP; therefore, when computed for Malawi, this scientist indicator produces a comparable figure to the financial investment indicator (or 0.28/0.39 = 0.72% of AGDP).

The first "research" degree in Anglo-American systems of higher education is the M.Sc. degree; in the French system, the equivalent is the Ingenieur Agronome. The goal of any national research system is to have all of its scientific staff with the minimum qualification of the first research degree or equivalent qualification. Therefore, a second indicator was to determine the percentage of Malawi scientists with post-graduate or formal research training (i.e. M.Sc., Ing. Agr. or Ph.D. degrees). Forty-five percent of the scientific staff currently hold post-graduate degrees; this level suggests impressive progress over the past two decades, since at independence there were only 2 Malawian research officers with B.Sc. degrees. The forthcoming USAID and World Bank research projects are expected to substantially increase the number of staff with formal research training and qualifications.

The technician-to-scientist ratio is a useful indicator to measure the number of support staff available to assist the scientific staff in carrying out their research program. Where scientific resources are in short supply, competent technicians can increase the overall efficiency of the research system. Normally, a 2-to-1 technician-scientist ratio is

recommended. In Malawi, since technical assistants are relatively well trained (normally only diplomates are considered to be "technicians"), they were included in the calculations, which found a 2.5 - 1 ratio. Malawi appears to have ample technical support for its scientific staff.

TD4. Access to External Technology

Indicator

A. Level of Contact (via genetic resources, training and consultations) from external research centers, such as International Agricultural Research Centers (IARCs) = 86%, or high contact.

Discussion

If a relatively small country like Malawi is to increase agricultural productivity it is important that it be well linked to external sources of technology, so that it can borrow, test and utilize improved technology from both neighboring countries and the international system. To get some measure of its access to external technology, a composite indicator was developed and data were collected on four commodities. The level of external access was very high for maize, groundnuts and beans; however, access for tobacco was low due to the lack of an organized international system for tobacco research.

TD5. Research Orientation

Indicator

A. Orientation of Research = primary focus on Technology, Assessment, and Adaptation

Discussion

A small, low income country like Malawi would be expected to invest its scarce research resources in such a way as to maximize agricultural productivity. This assumption calls for priority being given to the

development, assessment and adaptation of improved technology to meet the needs of its farmers. Through the use of different qualitative measures, it was found that the primary focus of the Malawi agricultural research system is devoted to assessing externally developed technology to determine its potential value to Malawi and, where potentially useful, then to adapt it to local needs and conditions. Where external technolcgy is not well suited for Malawi, for example improved varieties of groundnuts, then technology development research is also carried out. Developing and assessing technology is carried out through commodity research teams. Previously considerable adaptive research was carried out by the commodity research teams. This function is in the process of being transferred to the newly created Adaptive Research Teams (ARTs) which will be assigned to each ADD.

TD6. Research Outputs

Indicators

A. Output of research papers and technical reports per scientist/year = 0.4 papers/scientist/year.

B. Output of technical materials, such as new varieties or technical recommendations = 1.0 technical material or recommendation/scientist/year

C. Output of technology transfer activities, such as workshops, field days, etc = 6.6 technology transfer activities/scientist/year

Discussion

The research outputs of four commodity research programs (maize, groundnuts, beans and tobacco) were aggregated and averaged on the basis of three categories of research outputs, as noted above. In a research system that is heavily oriented toward technology development, assessment and

adaptation, it would be expected that the primary outputs would be related to new technology and its transfer to intermediaries (e.g. extension). Although there are no comparable measures on these indicators from other research systems, it appears that Malawi's agricultural research scientists are quite productive.

TD7. Access to Farmer Feedback

Indicator

Proportion of available research feedback channels utilized = 53% or moderate availability of feedback channels.

Discussion

For a research organization to stay abreast of farmers' problems so it can develop and/or adapt technology to meet farmer needs, it is essential that scientists have a variety of both formal and informal contacts, as well as direct and indirect (e.g. through extension) channels to farmer feedback. The availability of these different feedback channels were scored for each of the four selected commodity research programs, resulting in a relative score of 53%, or moderate availability of feedback channels. This rating may be somewhat better than the feedback actually received, since extension personnel felt that researchers did not listen very well or ignored the messages that they were communicating from farmers. The newly established research-extension workshops and committees, as well as the Adaptive Research Teams (ARTs) should improve these linkages among researchers, extension and farmers.

Technology Transfer

TT1. Financial Resources for Knowledge Transfer

Indicators

A. Financial Resources for Agricultural Extension = recurrent expenditures as a percentage of AGDP = 2.2% of AGDP; or 2.8% of "smallholder" AGDP.

B. Growth in Resources in real terms = 7.5% annual increase

Discussion

As discussed under P3, it was difficult to get a precise figure of government investment in "knowledge transfer" due to the mixing of recurrent expenditures from both the revenue and development accounts, and the inclusion of land husbandry and credit activities with the agricultural extension function. The above estimates of current allocations and growth appear to be accurate, given the available data.

There are no recommended parameters regarding adequate levels of investment in knowledge transfer (as is the case with agricultural research). Most African nations tend to allocate considerably more resources to the knowledge transfer function than to technology development, while industrially developed countries spend relatively fewer resources on the technology transfer function.

Malawi's current agricultural extension system serves only the smallholder sector, but plans are being made to provide extension services to the estate sector in the future, particularly for the small freehold or leasehold farmers. Therefore, overall knowledge transfer expenditures can be expected to increase. Given this situation, the 2.8% of "smallholder" AGDP is probably the more accurate estimate of current government

expenditures in knowledge transfer, or nearly 4 times the amount spent on agricultural research.

TT2. Allocation of Resources for Programs and Operations

Indicator:

Percent of recurrent expenditures allocated for Programs and Operations = these expenditures declined from about 47% in 1980/81 to 37% in 1985/86.

Discussion

As is the case for research, it is imperative that extension have a reasonable balance between resources for salaries as contrasted with those for program expenses. Generally, an equal balance between these two categories of expenditures would be expected in a well-functioning system. During the seventies it appears that a reasonable balance was maintained. With the beginning of the National Rural Development Program in 1978, there has been more than a doubling of the DOA staff coupled with a steady erosion in resources available for program and operations during the eighties. In the proposed 1985/86 budget, approximately 55% of the revenue budget was allocated to salaries and emoluments, with only 37% for program and operations.

In addition to this negative trend in the revenue budget, it is estimated that more than 40% of recurrent expenditures are being funded out of the development account, which is primarily donor-financed and designated for capital and infrastructure development. The obvious problem with this strategy is that when the development cycle has been completed for each RDP in an ADD, the entire cost of this expanded transfer system must be funded out of government expenditures (revenue account). Given the

experience of the first ADD to complete the development cycle, the recurrent cost problem is very serious, particularly in maintaining resources for programs and operation. In the Ngabu ADD, which has completed the development cycle, it was reported that 65% of its recurrent budget was spent on salaries, with the result that resources for programs and operations were grossly inadequate.

TT3. Human Resources for Knowledge Transfer

Indicators

A. Ratio of Farm Field Assistants to Farm Households = 1 FA:827 FH (1985)

B. Percentage of (crops and livestock) Subject Matter Specialists to overall extension staff = 2% SMSs with B.Sc. degrees or a ratio of 1 SMS to 48 field assistants; or alternatively, 4% SMSs, including specialist staff with both diplomas and degrees, or a ratio of 1 SMS (degrees + diplomas):23 field assistants.

C. Educational qualifications of extension supervisors = approximately 80% with diplomas, 20% with B.Sc. degrees; subject matter specialists = approximately 65% with diplomas; 35% with B.Sc. degrees; field assistants = 100% with certificates.

Discussion

The average ratio of field assistants to farm households is about at the level recommended by the World Bank under the T&V system of extension (1:800). However, there is considerable variation between ADDs. The range is from about 1:300 to 1:1400, depending in part upon whether the ADD has received development funding. There appears to be a clear need to reassign field personnel to get more uniform coverage throughout the country.

The role of subject matter specialists (SMS) is to link field extension staff with research, including both technical backstopping and in-service training functions. As the flow of technology increases in scope and complexity in any national system, the number and quality of SMS

staff needed can be expected to increase. In industrially developed countries, SMSs usually represent about 18-20% of the extension staff and nearly all would have post-graduate qualifications. The proportion of SMS in Africa and Asia with B.Sc. degrees averages around 6%. It would appear that the number and qualifications of SMSs in Malawi are very inadequate for the important linkage, training and backstopping tasks they are expected to perform. This serious deficiency in well trained SMSs appears to be the major human resource constraint facing extension.

TT4. Extension Linkage with Research

Indicators

A. Access to Technology from Research = frequency of contact with research through different channels = 64% or moderate to good access, but no access to location specific technology.

B. Output of Feedback to Research = frequency of contact through both formal and informal channels = 44% or moderate to poor output.

Discussion

There is no direct way to assess the quality and strength of linkages between research and extension. The method used in this study was to rate the frequency of contact between research and extension through specified formal and informal channels of potential transfer. Extension's access to improved technology appears to be relatively good at the national level, particularly through the annual Guide to Agricultural Production in Malawi. The different commodity research programs have carried out an extensive number of district trials in the past, however, these findings have not been made available to extension, so access to location specific technology has been very poor or non-existent. The Adaptive Research Teams (ARTs) are expected to begin increasing extension's access to location specific

technology.

The feedback to research was rated as moderate to poor, given the more limited frequency of contact through both formal and informal channels of communications. In addition, extension reported that research was not very attentive or responsive to the feedback they provided, so from extension's perception, feedback to research might be ranked as poor.

TT5. Time Allocated to Knowledge Transfer

Indicator

Percentage of time Field Assistant's spend on knowledge transfer = 80%

Discussion

Field assistants were reported to spend about 80% of their time on educational and related planning and reporting activities; most of their remaining time was spent on credit related activities. These percentages varied considerably between ADD, depending on the number of farmers using credit. Since only about 15% of the farmers are using credit at the present time, future credit-related activities can be expected to have a direct impact upon the time available for knowledge transfer if the number of farm clubs grows and percentage of farmers using credit increases.

TT6. Administration and Supervision

Indicators

A. Personnel Procedures and Sanctions = composite rating of the presence or absence of selected administrative tools = 75%, availability and/or utilization of most recommended tools.

B. Salary Index = composite index of extension salaries (compared to comparable professional groups) = 73% or salaries very comparable to similar professional groups in the country.

C. Field Staff Assignments = 4 years/assignment before being transferred; nearly all FAs live in their assigned work area.

Discussion

Generally, the administrative procedures and sanctions followed by the DOA are appropriate for supervising and evaluating staff performance. Like most civil service systems, it is difficult to terminate employees or to reward individuals for outstanding performance. Also, there is little incentive for personnel to obtain more education and training, or to generally improve professionally once in position. Otherwise, most recommended procedures are in place and are being used.

Salaries for extension personnel in Malawi are quite comparable to equivalent level positions in the country and provide for an adequate to good standard of living in Malawi. Extension assignments are of sufficient length so field assistants can be productive, yet they are not left in positions so long that they stagnate.

TT7. In-Service Training

Indicator

A. Average number of days of in-service training/year/field assistant = 30 days/year, or High

B. Quality of training was rated as Poor

Discussion

Malawi follows a modified Training and Visit (T&V) system of extension, involving fortnightly training, which accounts for the relatively high number of training days/year. However, it was frequently reported that training sessions tended to be lectures, covering repetitive material, with little new information and training sessions were widely considered to be boring. It is likely that the small number of marginally trained SMSs, who have limited contacts with researchers and their on-going

field trial and demonstration work, accounts for the poor ratings received for much of the in-service training.

TT8: Availability of Equipment, Teaching Aids and Mobility for Extension Personnel

Indicator

A. Percentage of field assistants who were physically mobile (i.e. had a bicycle) = 50-60%

B. Availability of Communication Equipment and Teaching Aids for Field Assistants = Very Poor

Discussions

For extension personnel to reach the clientele they are assigned to serve, and to do so efficiency, they need adequate and appropriate transport. Recently hired extension field staff have not had access to loans in order to obtain satisfactory transportation. In addition, most field assistants have very few teaching resources other than the annual Production Guide to use in teaching at group meetings.

TT9. Professional and Technical Backstopping

Indicators

A. Professional Backstopping = ratio of agricultural information officers to field assistants = 1:130 (due to vacancy problem)

B. Technical Backstopping = ratio of crops-livestock SMSs (with B.Sc. degrees) to field assistants = 1:48

The production of extension teaching aids or software is dependent upon having adequate numbers agricultural information specialists who can prepare and produce such aids. In a world-wide survey conducted by the author there was an average of 1 agricultural information specialist for every 59 field agents. The EAB has experienced high vacancy rates among

its professional staff in recent years and most of the effort is devoted to radio broadcasts and the mobile units, rather than producing teaching aids for the field staff. Therefore, it appears that field assistants in Malawi lack adequate professional backstopping.

The technical backstopping of field assistants was discussed earlier and, to repeat, it appears that the lack of SMSs is the most serious human resource deficiency in the transfer system.

TT10. Technical Dissemination

Indicators

A. Individual FA Activities or Contacts = 2.7 farmer contacts or farm visits/agent/day

B. Group meetings = 0.5 meetings/FA/day

C. Mass Media = Technical Broadcasts = 28 minutes of technical broadcasts/day

Discussion

Overall, it appears that the field staff are carrying out a sizeable number of extension activities per day, however, there is no indication as to the quality of these activities. Since field assistants have few teaching aids and are poorly backstopped technically, they are largely required to draw upon their own professional/technical resources (i.e. certificate level training) to make these activities interesting and useful to farmers.

The Extension Aids Branch appears to be well organized and efficient in carrying out technical radio programs. However, this is its primary activity and output. As mentioned above, the EAB does very little in the area of professional backstopping of field staff.

TT11. Extension Contact with Input Suppliers

Indicator

Level of extension personnel contact with ADMARC depots = "frequent" contact

Discussion

There appears to be a good enough working relationship between extension and ADMARC to insure that farmers get access to inputs and that crops get marketed. The level of contact appears to be especially high, both before and during the planting season when inputs are needed and following harvest when crops are marketed and loans repaid.

Technology Utilization

TV1. Farm Resources

Indicators

A. Mean size of farm = 1.17 hectares (ha)/farm household
B. Mean size of farm household = 4.5 persons
C. Average level of income/farm household = 137 Kwacha or about US$105
D. Education and literacy = 31% of heads of households have some schooling
E. Percentage of farmers having some off-farm employment = 60.8%

Discussion

It was reported that 1.25 hectares was the minimum size of farm necessary to support a farm household at the subsistence level of production. It was estimated that more than 60% of farm households are below this level. Furthermore, this percentage is increasing as the rural population grows at 2.9% annually. The average income level of farm households is quite low, although around 60% of farm households reported

having some off-farm employment. However, analysis of these data by size of farm holding suggests that the amount of underutilized labor per farm household increases as the size of land holding decreases. This suggests the need for more intensive farm operations and/or more off-farm employment. However, these smaller farm operations appear to have the least access to the improved technology (purchased inputs) that could increase their productivity and incomes. In fact, use of purchased inputs and productivity are directly correlated with size of holding.

TU2. Access to Technology Channels

Indicators

A. Households having a radio = 18%
B. Membership in Farm Clubs = 18.6%
C. Field Assistants/farm households = 1FA/828 FH (1985)
D. Field Assistants/cultivated area = 1FA/793 ha (1985)

As mentioned earlier in the technology transfer section, there are about 28 minutes of technical farm broadcasts/day, but the number of farm households with radios to receive these messages is limited. This deficiency was reported to be partially off-set through the use of radio listening groups. All broadcasts are in Chewa and it was asserted that most of the farm population understands Chewa.

Membership in a farm club is necessary to obtain credit for purchased inputs through ADMARC. Since farm household incomes are low, membership in farm clubs becomes a very important access channel to credit, purchased inputs and improved technology. Furthermore, since field assistants are directly involved in organizing and certifying clubs for credit, for supervising the use of purchased inputs and for monitoring repayment, it must be assumed that farm clubs are a major point of FA contact and

extension activity. Since only 18.6% of farm households are involved in a farm club, this suggests that only about one-fifth of farm households have regular access to technology through this important channel.

TV3. Farmer-Extension Contact

Indicators

A. Percentage of farmers having one or more farm visits annually = 3.5%
B. Percentage of farmers having group contact (meetings, etc) = 20%
C. Percentage of farmers attending a training center each year = <5%
D. Percentage of farmers attending a field day or demonstration = 6%

Discussion

The proportion of farmers having direct contact with a field assistant during a one-year period was estimated at between 20-25% of all farmers. A smaller proportion of this group received multiple or intensive contacts, which is particularly important at the "evaluation" or "decision" stage of the adoption process. The level of contact probably varied greatly across the country given the wide range of field assistant-farm household ratios (i.e. a range of 300-1400 farm households served by a single field assistant). Overall, the level of farmer-field assistant contact appears to be adequate and consistent with the field assistant-farm household ratio (TU2c) and the average level of extension activities (TT1G) carried out weekly by a field assistant.

TU4. Access to Physical Inputs

Indicators

A. Percentage of Farm Households with 8 Kilometers (5 miles) of an ADMARC depot = 76.5%
B. Density of input supply points = number of farm households (1.27 million) served by an ADMARC depot (1020) = 1245 FH/depot (1984)

Discussion

ADMARC has an extensive network of input supply/marketing stations or depots located throughout the country and this number is growing as ADMARC expands its outlets through the National Rural Development Program (NRDP).

TU5. Utilization of Technology

A. Percentage of farmers using improved maize composites/hybrids = approximately 10%

B. Percentage of farmers using fertilizer = increased from about 13% in 1968/69 to 33% in 1980/81

C. Amount of fertilizer used/hectare of cropped land (smallholders only) = increase from about 12kg/ha in 1970 to about 50kg/ha in 1984/85 or a 22% annual increase

D. Percentage of farmers using recommended cultural practices = approximately 70%

E. Increased utilization of improved technology, especially purchased inputs, is directly correlated with increase in farm size. For example, in 1980/81 the average maize yields of farm households with 0.5 ha or less was 970 kg/ha, while smallholders with 3 or more hectares of land had average yields of 1687 kg/ha.

Discussion

Farmers in Malawi are rapidly increasing their use of improved technology, especially recommended cultural practices, and to a lesser extent fertilizer. The use of pesticides is primarily found in the estate sector, but the use of these agricultural chemicals by smallholders is growing and can be expected to increase rapidly as supplies and credit become available.

The use of purchased inputs by smallholders appears to be directly related to farm size and membership in farm clubs. While extension contact does not appear to be biased toward larger farmers, access to credit through farm clubs and to purchased inputs appears to favor the larger,

higher resource farmers. If this pattern continues, without increased effort and attention being given to organize smaller farmers (including women headed farm households) into farmer clubs and their being given access to credit, the result could be an increasingly differentiated agricultural sector.

Clearly, Malawi does not have the industrial capacity to effectively absorb large numbers of rural people into urban or off-farm employment. Therefore, it is very important that the majority of rural people have access to the improved technology, including purchased inputs, so they can increase their productivity and incomes, and continue contributing to the agricultural and national economy. If the smallholder sector becomes more highly differentiated, while average farm size grows smaller, then the likely consequences could be increased rural poverty and more rapid rural-urban migration.

GENERAL CONCLUSIONS

The agricultural technology system in Malawi has made impressive progress since independence in 1964. The basic institutional capacity has been or is being improved to develop, test, adapt and transfer improved technology to farmers. At the same time, it was found that smallholders in Malawi are responsive to price incentives and many are increasing their utilization of improved technologies and cultural practices. The primary constraint to the more rapid up-take of improved technology, especially purchased inputs, appears to be the lack of credit.

The following section will summarize the primary strengths and weaknesses of the technology system as identified throughout the case study, using the INTERPAKS analytical model and concomitant indicators. The weaknesses identified should not necessarily be viewed as negative criticism, but as areas needing policy attention as the government continues its pragmatic approach to improving the overall agricultural technology system in Malawi.

General Strengths

1. Strong and continuing government commitment to the agricultural sector and its development, as evidenced by:

   (a) the use of price incentives to increase production;

   (b) the use of scarce foreign exchange to import agricultural inputs; and

   (c) adequate investment in both the institutions and infrastructure needed to support increased productivity and growth in the agricultural sector.

2. A well organized and productive agricultural research system aimed at technology development and transfer, as evidenced by:

   (a) a strong orientation toward borrowing, testing and adapting technology from the international system for use by smallholders;

   (b) a high level of research outputs/scientists;

   (c) a growing number of national scientists with post-graduate qualifications;

   (d) an ample number of technicians to efficiently support the scientific staff, and

   (e) a minimum necessary level of investment (0.72% of AGDP) in agricultural research, that is growing at about 5%/year in real terms.

3. A well organized knowledge and technology transfer system, as evidenced by:

   (a) an adequate field assistant-farm household ratio;

   (b) a productive field staff, in terms of dissemination activities completed;

   (c) the proportion of time field assistants spend on knowledge transfer activities;

   (d) an effective personnel management system, including competitive salaries;

   (e) an adequate level of recurrent expenditures to support the knowledge transfer function; and

   (f) an adequate number of ADMARC depots to allow most farmers convenient access to input supplies and a market for their surplus production.

Constraints and Other Factors Requiring Policy Attention

1. Investments in agricultural research should continue to move toward the 1% of AGDP level of recurrent expenditure, while paying attention to keeping resources for programs and operations in balance with resources for salaries and emoluments.

2. Comparative allocation of resources to the maize, roots and tubers, groundnut, tobacco, horticulture and agro-forestry commodity research programs should be carefully examined and additional resources made available where needed and necessary.

3. The training and technical support of the Adaptive Research Team need immediate attention to increase the flow of location-specific technology to farmers in different agro-ecological zones of each ADD.

4. The linkages between research, extension and farmers should be regularly monitored to insure that research has access to and is receiving farmer feedback.

5. There is a need for more systematic and streamlined research procedures are needed to test and approve new technical inputs for use by farmers.

6. Immediate attention should be given to the poor quality of in-service training and the general lack of technical backstopping being received by field assistants. This can be aided by increasing numbers of well trained subject matter specialists at the RDP and ADD levels in the extension system. This will become increasingly important as the ARTs begin to function in each ADD, producing location specific technical recommendations that must be packaged and disseminated.

7. As the ARTs become functional, there will be need for additional well trained and equipped agricultural information specialists will be needed to produce relevant teaching aids for use by field assistants.

8. There should be immediate attention to the lack of physical mobility by nearly one-half of the field staff.

9. There is a need for increased attention to the general lack of communication/teaching equipment and teaching aids used by all extension personnel.

10. There ought to be expanded use of both performance incentives and rewards for professional improvement.

11. There is need for immediate attention to the recurrent cost problem facing the DOA, with specific attention being given to the balance between salaries and program expenditures.

12. Immediate attention should be paid to price policy and the analytical procedures used to set pan-national commodity prices.

13. There is need for increased amounts, and expanded availability, of production credit, particularly to the smaller farm households. This recommendation implies the need to organize and service expanded numbers of farmer clubs, particularly for small farmers, including those households headed by women farmers.

14. Finally, attention is needed regarding how credit packages are developed and approved at the ADD level so that farmers will have ready access to all recommended inputs.

MALAWI REFERENCES

Adaptive Research Programme. Management Unit. Chitedze Agricultural Research Station. (1984). Farming system overview EPA 22 in the Lilongwe North East Rural Development Project: Results of an exploratory survey, 12-14 March 1984. Lilongwe: Chitedze Agricultural Research Station. 12 pp. Mimeographed.

Agricultural Development and Marketing Corporation. (1984). Annual accounts and report for the year ended 31st March, 1984. Limbe, Malawi: Agricultural Development and Marketing Corporation. 24 pp.

Agricultural Development and Marketing Corporation. (1981). Chairman's report and annual accounts for the year ended 31st March, 1981. Limbe, Malawi: Agricultural Development and Marketing Corporation. 27 pp.

Belay, H. S. (1975). A comparative analysis of agricultural extension systems. Journal of the Association for the Advancement of Agricultural Sciences in Africa, 2, Supplement, 316-320.

Bieze, T. W. (1973). The agro economic survey of Malawi. Eastern Africa Journal of Rural Development, 6, 143-156.

Chipande, G. H. R. (1983). Smallholder agriculture as a rural development strategy: The case of Malawi. Unpublished Ph.D. dissertation, Department of Political Economy, University of Glasgow. 274 pp.

Chipeta, W. (1972). The nature and significance of resources used in Malawian peasant agriculture. Africa Quarterly, 11, 307-317.

Clark, B. A. (1975). The work done by rural women in Malawi. Eastern African Journal of Rural Development, 8, 80-91.

Curtis, J. M., Qamar, M. K., Spatrisona, J. (1982). An assessment of agricultural extension and training in Malawi. n.p.: A. L. Nellum and Associates. 94 pp. Mimeographed.

Deloitte, Haskins & Sells. (1984). Study of the proposed agricultural development. Unpublished report.

Farrington, J. (1977). Efficiency in resource allocation - a study of Malawi smallholders' performance. Tropical Agriculture, 54, 97- 106.

Farrington, J. (1975). Factors influencing the length of working day in Malawi agriculture. Eastern African Journal of Rural Development, 8, 61-79.

Farrington, J. (1977). Research-based recommendations versus farmers' practices: Some lessons from cotton-spraying in Malawi. Experimental Agriculture, 13, 9-15.

Fletcher, L. B., Merrill, W. C. (1980). Malawi's agricultural and rural development: An assessment of priorities for AID assistance. Ames, IA: Department of Economics, Iowa State University. 117 pp.

Fleuret, P. (1984). Agricultural institutions in Malawi: Issues options, and program implications. Unpublished first draft. 72 pp.

Futures Group. (1981). Malawi: The effects of population factors on social and economic development. Washington, D.C.: The Futures Group. 60 pp.

GITEC Consult GMBH. (1983). National credit study (smallholders): Final report, phase I. Duesseldorf: GITEC Consult GMBH. 2 volumes.

Gondwe, E. L. C. (1982). Block extension system in Mzuzu Agricultural Development Division. Unpublished paper. 6 pp. Mimeographed.

Heyneman, S. P. (1980). The evaluation of human capital in Malawi. Washington, DC: World Bank. 101 pp. (World Bank staff working paper no. 420)

Hirschmann, D., Vaughan, M. (1983). Food production and income generation in a matrilineal society: Rural women in Zomba, Malawi. Journal of Southern African Studies, 10, 86-99.

Hirschmann, D., Vaughan, M. (1984). Women farmers of Malawi: Food production in the Zomba District. Berkeley, CA: Institute of International Studies, University of California. 142 pp. (Research series, no. 58)

Hoffmann, H. K. F. (1967). Case studies of progressive farming in Central Malawi. Lilongwe, Malawi: Malawi Government. 70 pp. Mimeographed.

Hull, G. E. (1983). Agricultural Extension, Department of Agriculture, Ministry of Agriculture: Observations and recommendations. Arlington, VA: International Agricultural Development Service. 45 pp. and annexes.

Humphrey, D. H. (1975). Socio-economic aspects of rural development in Malawi: A report on some survey findings. Eastern African Journal of Rural Development, 8, 46-60.

Ian MacDonald and Associates Ltd. (1985). Manpower development and training needs study. Limpsfield, Surrey, England: Ian MacDonald and Associates Ltd. 2 vols.: 177, 114 pp.

International Livestock Centre for Africa. Documentation Services. (1984). Index to livestock literature microfiched by the ICLA/IDRC team in Malawi. Addis Ababa, Ethiopia: International Livestock Centre for Africa. 72 pp. (IDRC-MP/MW-575/83)

International Monetary Fund. (1983). Malawi: Recent economic developments. Washington, D.C.: International Monetary Fund. 79 pp.

International Service for National Agricultural Research. (1982). A review of the agricultural research system of Malawi. The Hague: International Service on National Agricultural Research. 88 pp. (ISNAR R8)

Kabuye, E. S. (1982). Agriculture extension in Malawi: Past, present and future strategies. Paper presented at the Home Economics Workshop, Bunda College of Agriculture, University of Malawi on July 20, 1982. 10 pp. Mimeographed.

Kabuye, E. S. (1982). Block agricultural extension approach: Experiences as implemented in Mzuzu Agricultural Development Division. Paper presented at the Department of Agricultural Development Conference held at Club Makokola, Malawi, from August 8-14, 1982. 25 pp. Mimeographed.

Kinsey, B. (1981). Monitoring large-scale agricultural development projects: Lilongwe, Malawi. In E. Clayton and F. Petry (Eds.), Monitoring Systems for agricultural and rural development projects (pp. 59-81). (FAO economic and social development paper 12 En). Rome: Food and Agriculture Organization of the United Nations.

Kirchner, J., Squire, L., Singh, I. (1985). Agricultural pricing in Malawi: A reduced-form model. Washington, DC: Country Policy Department, World Bank. 100 pp. Mimeographed draft. (CPD discussion no. 1985-9)

Kydd, J. (1982). Measuring peasant differentiation for policy purposes: A report on a cluster analysis classification of the population of the Lilongwe Land Development Programme, Malawi, for 1970 and 1979. Zomba: Government Printer. 248 pp.

Kydd, J., Christiansen, R. (1982). Structural change in Malawi since independence: Consequences of a development strategy based on large-scale agriculture. World Development, 10, 355-375.

MacDonnell, P.D. deC. (1973). Agricultural extension in Malawi. Rural Africana, No. 21.

Malawi. Department of Surveys. (1985). Development programme maps 1983/84 - 1985/86. Blantyre: Department of Surveys. 36 pp.

Malawi. Extension and Training. (1984). Job descriptions. Unpublished document. 10 pp. Mimeographed.

Malawi Government. (1964 -). Annual economic survey. Zomba: Government Printer. Annual.

Malawi Government. Approved estimates of expenditure on development account for the financial year. Zomba: Government Printer. Annual.

Malawi Government. (1985). Financial statement 1985/86. Zomba: Government Printer. 15 pp. (Budget document no. 3)

Malawi. Liwonde Agricultural Development Division. Planning and Evaluation Section. (1985). The recurrent annual costs of agricultural services under the NRDP: The case of Liwonde A.D.D. Liwonde: Liwonde Agricultural Development Division. Planning and Evaluation Section. Various pagings. (Evaluation working paper)

Malawi. Liwonde Agricultural Development Division. (1983). Project handout: Four years of development promotion. Liwonde, Malawi: Liwonde Agricultural Development Division. Unpaged. Mimeographed.

Malawi. Ministry of Agriculture. Dept. of Agricultural Research. (1985). Crop production recommendations. Lilongwe: Department of Agricultural Research. 7 pp. Mimeographed.

Malawi. Ministry of Agriculture. Dept. of Agricultural Research. Local Preparation Team. (1983). Reorganisation of agricultural research: Research strategy and master plan; Second interim report to the Steering Committee. n.p.: Ministry of Agriculture, Dept. of Agricultural Research. 44 pp. Mimeographed.

Malawi. Ministry of Agriculture. Extension Aids Branch. Extension aids circular. Lilongwe, Malawi: Extension Aids Branch, Ministry of Agriculture.

Malawi. Ministry of Agriculture. (1984). National Rural Development Programme (NRDP) Lilongwe: Extension Aids Branch, Ministry of Agriculture. 8 pp.

Malawi. Ministry of Agriculture. Planning Division. Agro-Economic Survey. (1983). An analysis of agricultural commodity prices in selected local markets in Malawi: Working paper no. 5. Lilongwe: Agro-Economic Survey, Planning Division. 111 pp. Mimeographed.

Malawi. Ministry of Agriculture. Planning Division. (1985). Final report of the Advisor on Pricing Policy. Lilongwe, Malawi: Ministry of Agriculture. Planning Division. 26 pp. Mimeographed.

Malawi. Mzuzu Agricultural Development Division. Evaluation Unit. (1985). Rumphi-North Mzimba Rural Development Project annual work plan 1984/1985. n.p.: Evaluation Unit, Mzuzu A.D.D. 26 pp. Mimeographed.

Malawi. Mzuzu Agricultural Development Division. Evaluation Unit. (1985). Central Mzimba Rural Development Project annual work plan 1984/1985. n.p.: Evaluation Unit, Mzuzu A.D.D. 22 pp. Mimeographed.

Malawi. Mzuzu Agricultural Development Division. Evaluation Unit. (1984). Modified extension survey 1984. Mzuzu, Malawi: Evaluation Unit, Mzuzu Agricultural Development Division. 25 pp. Mimeographed.

Malawi. Mzuzu Agricultural Development Division. Evaluation Unit. (1985). Nkhata Bay Rural Development Project annual work plan 1984/1985. n.p.: EValuation Unit, Mzuzu A.D.D. 17 pp. Mimeographed.

Malawi. Mzuzu Agricultural Development Division. Evaluation Unit. (1985). South Mzimba Rural Development Project annual work plan 1984/1985. n.p.: Evaluation Unit, Mzuzu A.D.D. 22 pp. Mimeographed.

Malawi. Mzuzu Agricultural Development Division. (1985). Womens Programme Survey 1984. Mzuzu: Mzuzu Agricultural Development Division. 37 pp. Mimeographed.

Malawi. National Statistical Office. (1964). Annual statement of external trade. Zomba: Government Printer. Annual.

Malawi. National Statistical Office. (1968-). Compendium of agricultural statistics. Zomba: Government Printer. Irregular.

Malawi. National Statistical Office. (1984). Malawi population census 1977: Analytical report. Zomba: Government Printer. 2 volumes.

Malawi. National Statistical Office. (1980). Malawi population census 1977: Final report. Zomba: Government Printer. 2 volumes.

Malawi. National Statistical Office. (1972 -). Malawi statistical yearbook. Zomba: Government Printer. Annual.

Malawi. National Statistical Office. (1984). Monthly statistical bulletin, November 1984. Zomba, Malawi: National Statistical Office. 26 pp.

Malawi. National Statistical Office. (1982 -). National accounts report. Zomba: Government Printer. Annual.

Malawi. National Statistical Office. (1984). National sample survey of agriculture 1980/81. Zomba: Government Printer. 3 volumes.

Malawi. National Statistical Office. (1970). National sample survey of agriculture 1968/69. Zomba: Government Printer. 172 pp.

Malawi. National Statistical Office. (1984). Reported employment and earnings annual report 1977-1979. Zomba: National Statistical Office. 33 pp.

Malawi. National Statistical Office. (1980 -). Transport statistics. Zomba: Government Printer. Annual.

Malawi. National Statistical Office. (1983). Urban household expenditure survey 1979/80. Zomba: Government Printer. 144 pp.

Malawi. Ngabu Agricultural Development Division. (1985). Annual Surveys of Agriculture (A.S.A.) reports. Ngabu, Malawi: Evaluation Unit, Ngabu Agricultural Development Division. Unpublished memorandum. 19 pp. Mimeographed.

Malawi. Ngabu Agricultural Development Division. (1985). Progress report for 1985/86 and annual work plan for 1986/87 financial years. n.p.: Ngabu Agricultural Development Division. 58 pp. Mimeographed.

Malawi. Office of the President and Cabinet. Economic Planning Division. (1985). Economic report 1985. Zomba: Government Printer. 102 pp. (Budget document no. 4)

Malawi. Office of the President and Cabinet. Economic Planning Division. (1971). Developing Malawi. Zomba: Government Press. 75 pp.

Manda, D. R. B., Dzowela, B. H., Johnson, W. H. (1985). Agricultural research resource assessment in the SADCC countries. Volume II - Country report: Malawi. Gaborone, Botswana: Southern African Development Coordination Conference, Consultative Technical Committee for Agricultural Research and Devres, Inc. 109 pp. mimeographed.

Namkumba, J. S. (1980). Complicated procedures or credit for the asking? A pragmatic approach to credit use in Malawi. Journal of Social Science, 8, 60-77.

Nankumba, J. S. (1982). Stallfeeder credit programme in Malawi: A study with special reference to the Lilongwe Land Development Programme. Agricultural Administration, 9, 103-114.

National Sample Survey of Agriculture Seminar (Blantyre: 7-11 May 1984) (1984). Report on the National Sample Survey of Agriculture Seminar. Zomba: National Statistical Office. 39 pp.

Nelson, H. D., Dobert, M., McDonald, G. C., McLaughlin, J., Marvin, B., Whitaker, D. P. (1975). Area handbook for Malawi. Washington, D.C.: U.S. Government Printing office. 353 pp. (DA PAM 550-172)

Ogbu, J. U. (1978). Economic transition among the Poka of northern Malawi: From subsistence to cash cropping. Journal of African Studies, 7, 151-172.

Perraton, H., Orivel, F., Jamison, D. T., Wolff, L., Jenkins, J. (1983). Basic education and agricultural extension: Costs, effects, and alternatives. Washington, DC: World Bank. 285 pp. (World Bank staff working papers no. 564)

Perraton, H., Jamison, D. T., Orivel, F. (1983). Mass media for agricultural extension in Malawi. In Basic education and agricultural extension: Costs, effects, and alternatives (pp. 147- 201) (World Bank staff working papers no. 564). Washington, DC: World Bank.

Phipps, B. (1976). Evaluating development schemes: Problems and implications. A Malawi case study. Development and Change, 7, 469-484.

Richards, E. M. (1978). An exercise in the use of gross margins for the analysis of farm management survey data (Henga/Kasitu Valley National Rural Development Project Area) Journal of Social Science (University of Malawi), 7, 34-51.

Schaefer-Kehnert, W. (1980). Success with group lending in Malawi. Quarterly Journal of International Agriculture, 19, 331-337, Development Digest, (1982), 10-15.

Spring, A., Smith, C., Kayuni, F. (1983). Women farmers in Malawi: Their contributions to agriculture and participation in development projects. Washington, DC: USAID, Office of Women in Development. 80 pp.

Spring, A. (1985). The Women in Agricultural Development Project in Malawi: Making gender free development work. In R. S. Gallin and A. Spring (Eds.), Women creating wealth: Transforming economic development (pp. 71-75). Washington, DC: Association for Women in Development.

Stockhausen, J. Von. (1982). Credit groups and rotating savings and credit associations - different financial technologies? Quarterly Journal of International Agriculture, 21, 155-172.

U.S. Agency for International Development. (1985). Agricultural research and extension (612-0215): Project paper. Lilongwe: USAID/Malawi. Fourth draft. 2 volumes.

United Nations Development Programme. (1985). Agricultural produce marketing - Malawi. Unpublished project document. 16 pp. Mimeographed.

University of Edinburgh. Centre of African Studies. (1985). Malawi: An alternative pattern of development. 642 pp. (Centre of African Studies seminar proceedings, no. 25)

USAID/Malawi. (1984). Country development strategy statement: Malawi. Washington, DC: Agency for International Development. 72 pp.

Tea Research Foundation. (1976 -). Annual report of the Director, Tea Research Foundation to the annual general meeting of the Tea Association (C.A.) n.p.: Tea Research Foundation.

Vincent, V. (1962). Extension methods in Southern Africa. 8 pp.

Wolgin, J., Clapp-Wincek, C., Honadle, G., Mahoney, T., Penner, T. (1983). The private sector and the economic development of Malawi. Washington, DC: U.S. Agency for International Development (AID) 46 pp. (AID evaluation special study no. 11, PN-AAL-006)

World Bank. Eastern Africa Projects Department. Southern Agriculture Division. (1985). Staff appraisal report: Malawi National Agricultural Research Project. Washington, DC: World Bank. 85 pp. (Report no. 5295-MAI)

World Bank. Eastern Africa Projects Department. Southern Agriculture Division. (1984). Malawi: Agricultural diversification. Washington, DC: World Bank. 124 pp. (Report no. 4898-MAI)

World Bank. Eastern Africa Projects Department. Southern Agriculture Division. (1982). Malawi: National Rural Development Program (NRDP) review. Washington, DC: World Bank. 181 pp. (Report no. 3895-MAI)

World Bank. Eastern and Southern Africa Projects Department. Southern Agriculture Division. (1985). Malawi: Agricultural Extension and Planning Support Project - Staff appraisal report. Washington, DC: World Bank. Draft. 65 pp. and appendices. (Report no. 5453-MAI)

PRINCIPAL ABBREVIATIONS AND ACRONYMS

ADD	-	Agricultural Development Division
ADMARC	-	Agricultural Development and Marketing Corporation
ARC	-	Agricultural Research Council
ART	-	Adaptive Research Team
CAO	-	Chief Agricultural Officer (Extension)
CARO	-	Chief Agricultural Research Officer
CAS	-	Controller of Agricultural Services
CDA	-	Cooperation for Development of Africa
CIAT	-	Centro Internacional de Agricultura Tropical
CIMMYT	-	Centro Internacional de Maiz y Trigo
CIP	-	Centro Internacional de la Papa
CRSP	-	Collaborative Research Support Program (USAID)
CRT	-	Commodity Research Team
CTL	-	Commodity Team Leader
DAR	-	Department of Agricultural Research
DOA	-	Department of Agriculture (Extension)
EPA	-	Extension Planning Area
GOM	-	Government of Malawi
IARCs	-	International Agricultural Research Centers
ICRISAT	-	International Crops Research Institute for the Semi-Arid Tropics
IITA	-	International Institute of Tropical Agriculture
ILCA	-	International Livestock Center for Africa
ISNAR	-	International Service for National Agricultural Research
MFNR	-	Ministry of Forestry and Natural Resources
MOA	-	Ministry of Agriculture
NRC	-	National Research Coordinator
NRDP	-	National Rural Development Program
ODA	-	Overseas Development Administration (UK)
OPC	-	Office of President and Cabinet
PO	-	Professional Officer
RDP	-	Rural Development Project
SADCC	-	Southern African Development Coordination Conference
SAL	-	Structural Adjustment Loan
SMS	-	Subject Matter Specialist (Extension)
SUCOMA	-	Sugar Corporation of Malawi
T&V	-	Training and Visit System
TA	-	Technical Assistant
TDRI	-	Tropical Development and Research Institute
TO	-	Technical Officer
TRA	-	Tobacco Research Authority
TRF	-	Tea Research Foundation
UNDP	-	United Nations Development Program
USAID	-	United States Agency for International Development