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IFDC/IFPRI FERTILIZER POLICY PROJECT

ECONOMIC POLICY REFORMS AND FERTILIZER USE IN SMALLHOLDER AGRICULTURE IN MALAWI

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SUMMARY

Malawi introduced several policy reforms even before the structural adjustment program in 1981 to improve its food self-sufficiency and to expand its export crop base. These goals were to be achieved through intensification of maize production and through the reallocation of farmland away from maize and traditional export crops (tobacco, sugar, tea, and coffee) to new export crops. In addition, both the yields of maize and export crops were to be enhanced through a widespread use of fertilizers sand hybrid maize variety.

The study indicates that during the pre-adjustment (1971-78) period, the maize yield and area increased respectively at an average annual rate of about 2.1 percent and 0.9 percent. During the adjustment (1979-83) period, both the yield and the area under maize crop declined respectively at an annual rate of 1.9 percent and 0.7 percent. The production of maize did not improve during the post-adjustment (1984-87) period. As expected from SAP, the area under maize decreased by 1.0 percent per year. This area contraction was accompanied by a 1.5 percent annual declined in maize yield. This led to 2.5 percent decrease in maize output per annum.

The deterioration of the maize production was further compounded during the post-adjustment (1984-87) period by a reduction in land area allocated to other food crops and minor export crops, all of which fall under the smallholder sector. The yields of these crops must have declined as most of these minor food crops not only attract little or no fertilizers as they are primarily subsistence-oriented, but also tend to

be cropped on poor land and the fallow system tends to disappear as a result of population pressures on land.

Considering the export crop diversification program, the study shows that the area under predominantly smallholder export crops (groundnut and cotton) declined at a rate of 0.8 percent per year, while the area under predominantly estate crops (tobacco, sugar, tea, and coffee) increased at an annual rate of 2.9 percent during the study (1970-88) period. The total area cultivated under nontraditional export crops remains negligible. It is clear from this analysis that the government did not give smallholder farmers -- who control, as a group, the bulk of the land -- the needed incentives for them to expand their export crop base significantly.

The fertilizer-seed technology, considered as the cornerstone of the policy reforms, failed to be widely adopted. The overall growth rate of fertilizer nutrient consumption fell from 6.4 percent per year during the pre-adjustment (1972-78) period to -1.2 percent during the adjustment (1979-83) period, and then regained its pre-adjustment level (about 6.6 percent per year during the 1984-88 period). During the 1980-88 period, the share of maize area under local variety rose and that under composite and hybrid varieties fell. This suggests that these policy reforms failed to affect significantly and positively the key factors influencing the adoption of fertilizer-seed technology in the smallholder sector of Malawi.

The data, based on annual survey of agriculture, indicate that the response of local maize to fertilizer use is about 11.4 kg of maize per kg of fertilizer (N and P_2O_5) nutrients, 13.1 kg for composite maize, and

33.0 kg for hybrid maize. The rates of fertilizer nutrients used by smallholder farmers during the 1982/85 period were about 26.7 kg of fertilizer nutrients per hectare for local, 45.6 kg for composite, and 52.0 kg for hybrid maize. These rates are substantially lower than the recommended rates of 39.0 kg of fertilizer nutrients per hectare for local, 92.0 kg for composite, and 132.0 kg for hybrid maize.

The analysis of the response curve shows that the rates of fertilizer nutrients used by farmers are technically and economically appropriate. Overall, they correspond to the highest maize response that could be obtained given the crop management techniques and other agricultural practices currently used by the smallholder farmers in Malawi. The recommended rates for different maize varieties are too high and make little technical and economic sense. This result contradicts some researchers who suggest that much effort is needed to encourage most smallholder farmers in Malawi to use the recommended rates of fertilizer nutrients per hectare of fertilized land area. Their conclusion appears not to be based on a rigorous analysis of the farm-level input-output data.

Fertilizer price has increased at a rate much faster than the smallholder prices for maize, rice, and tobacco during the adjustment and post-adjustment periods. Increases in fertilizer prices at the farm level were mostly due to increased import prices, domestic marketing costs, and external transport costs. The increases in import prices and external transport costs, although substantial remain relatively much lower than the increases in the domestic marketing costs. Furthermore, Malawi has largely relied on low analysis fertilizers. The price paid

to maize producers is much higher than the world price. Therefore, there is little the Government of Malawi can do to further increase this price. For rice and tobacco, the export tax has depressed the prices of these crops at the smallholder level. The returns of fertilizer use decreased during the period because of the worsening of the terms of trade between fertilizers and crops.

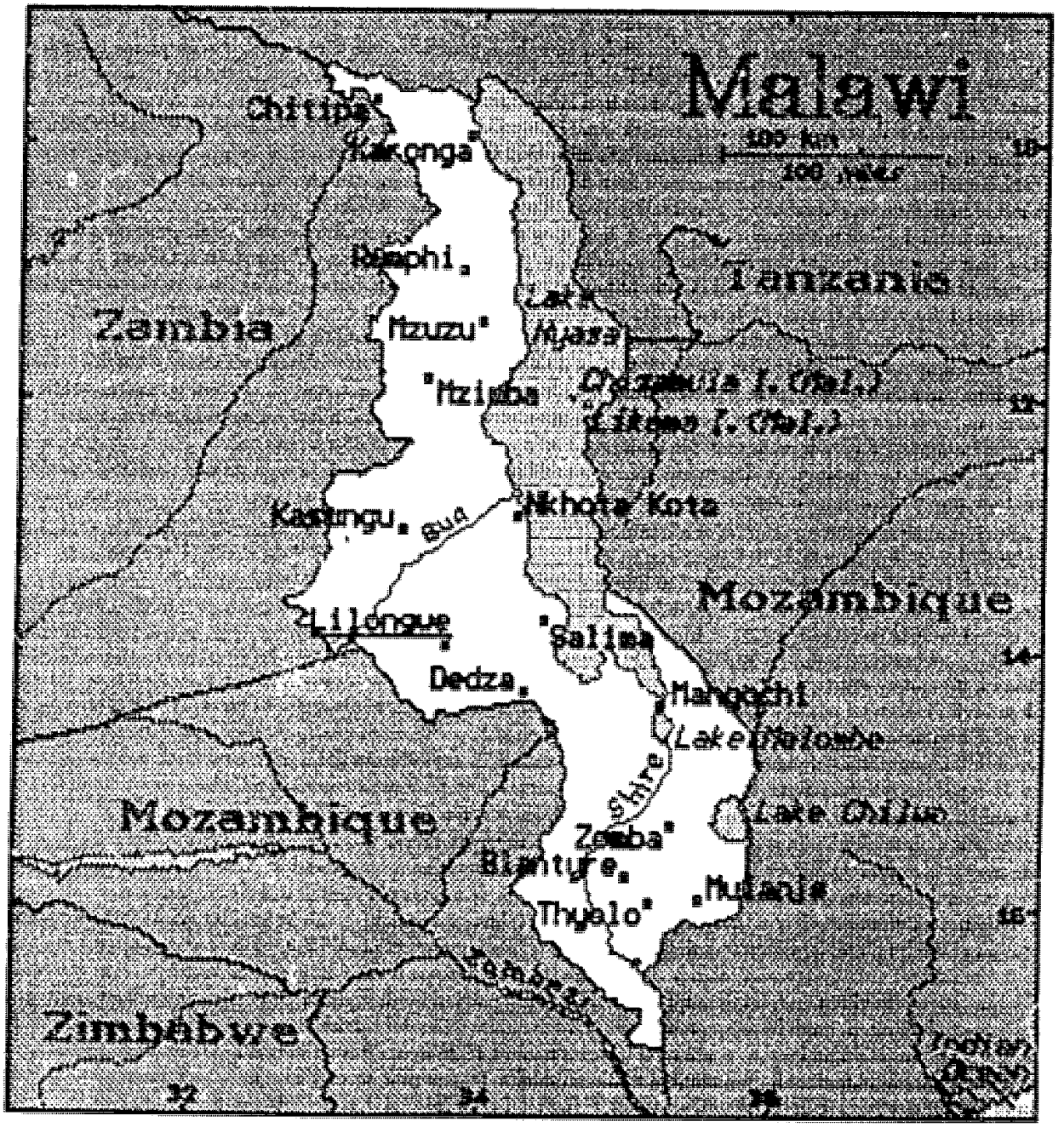
To reduce the farm level terms of trade between fertilizers and maize, rice, and tobacco, the Government of Malawi should explore the possibility of liberalizing and privatizing the domestic fertilizer delivery and crop marketing systems. Trade taxes on rice, tobacco and any other crops should be phased out. Government should raise its revenue through land, income and sales taxes, instead of trade taxes. A widespread use of high analysis fertilizers, consistent with the ecology, will also help reduce costs at the farm level. In addition to the terms of trade, fertilizer use also depends on a number of nonprice factors. Efforts to enhance the diffusion of appropriate fertilizer use and other agricultural practices, and to extend the formal credit to most smallholder farmers should be pursued vigorously.

INTRODUCTION

Malawi is a poor densely-populated and landlocked country in the southeastern part of Africa (see map). With an estimated per capita income of less than US$200, it is one of the poorest countries in the world. The country has no known substantial mineral resources. In its attempts at developing its national economy, Malawi has initiated various policies and experienced many impediments. This introductory chapter reviews different issues and economic policy events which took place in Malawi during the 1970-90 period, describes the position of agriculture in the economy of Malawi and presents the agricultural development policies and strategies followed during the period. Finally, the chapter states the objectives of the study, presents the plan of this work, and lists the sources of data used.

1.1 SURVEY OF EVENTS AND ECONOMIC POLICIES IN MALAWI

During the 1970-90 period, the first shock that hit Malawi was a groundnut disease, known as rosette, that affected about 50 percent of the crop during the 1972-73 crop year. During the same year, there were increases in fertilizer prices and this went a long way to affect maize yields. The growth rate of maize was found to be -0.8% and -5.6% for 1973 and 1974 respectively, as shown in the table on rate of growth of the yield of maize based on 3-year moving averages (Table 2.2). It must


Malawi
100 km
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Chitipa
Karonga
Rumphi
Mzuzu
Mzimba
Lake Nyasa
Tanzania
Zambia
Likoma I. (Mal.)
Nkhata Kota
Kasungu
Lilongue
Salima
Mozambique
Dedza
Mangochi
Lake Malombe
Lake Chilwa
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be added that there were poor rains during the 1972/73 crop year.

The principal event of the 1973/74 year was a doubling of prices of 20:20.0, CAN and SA fertilizers and this had the effect of discouraging farmers from applying fertilizers as intensively as the government policies were targeting. In 1977 however, the terms of trade of Malawi reached a peak level. This positive effect was further boosted by a large expansion in the activities of the estate subsector, which generated a rapidly growing volume of tobacco exports.

A strategic point in the economic history of Malawi corresponds with the year 1978. It was the year in which the decision was made to undertake structural changes in the Integrated Rural Development Program, to make it more applicable to the smallholder subsector. This is why the National Rural Development Program was launched. Its main objective was the extension of the benefits of rural development at a faster rate. In this same year, the export incentive act was instituted to provide incentives to producers. This act was applicable to industries as well. This act was then followed up with a macro policy agreement with the International Monetary Fund (IMF) in October 1979 and April 1980. The implementation of these policy agreements were, however, incomplete.

After the above experiences, Malawi decided to apply the structural adjustment program in 1981. It was then granted the first World Bank loan. In August of the following year, a third macro policy agreement was signed with the IMF and this was completed in August 1983. September 1982 was the month in which Malawi had to reschedule her debts at the Paris Club. It must be stated however, that the prices of

fertilizers had risen many times between 1981/82 to 1982/83 and this was due to the world oil crisis. Within the same period, Malawi suffered another setback, as the traditional import routes through Mozambique became unreliable as a result of civil war in that country.

There was another debt scheduling in March 1983 by the Commercial Bank of Malawi, and this was followed by a Fertilizer Policy Agreement with the World Bank in the next month, April 1983. Another macro policy was then signed with the IMF, and unlike the ones before the implementation, was smooth until April 1986. In October of 1983 debts were again rescheduled by Commercial Banks. That same year, a Smallholder Fertilizer Revolving Fund was instituted and the second World Bank loan was provided.

Malawi finally had to face up to a virtual cessation of its external transportation through the Mozambican routes during the 1983/84 years. The rail link through Mozambique was cut off completely and all imports were diverted over long and expensive road and rail links, primarily through the port of Durban in South Africa. This raised the estimated CIF/FOB margin for imports from 1.27 in 1980 to 1.67 in 1988, so that transport costs were at the time estimated to be 40% of the CIF value of imports.

The Third World Bank loan was negotiated in 1985. During the 1985/86 period, fertilizer prices became much higher than before and despite increased supplies and increased credit availability, the demand for fertilizers did not meet the desired levels. A consultative group of aid donors reviewed Malawi's economic policies in March 1986. The production of the smallholder subsector was hard hit again during

1986/87 due to high inflation rates and a series of droughts. It was during the 1984/87 period that the volume of marketed maize fell due to the decline in producer price of maize relative to fertilizers compared to the producer prices of competing crops. This pricing policy was adopted in order to promote crop diversification. During this same period, the influx of refugees from Mozambique increased thus complicating the food security problem in Malawi.

Over the 1983/88 period it is important to note that the Kwacha, Malawi's local currency, was devalued about 87 percent. It was in 1987/88 that the private sector started to benefit from a policy instrument of trade liberalizations and this led to a considerable decline in ADMARC's maize purchases.

ADMARC's balance between domestic purchases and sales of maize dramatically reversed in the years 1986-87 due to a variety of factors such as adverse weather conditions, the influx of a large number of Mozambican refugees, and the outbreak of the mealy bug pest which reduced the cassava harvest crop (the latter two factors increasing the demand for maize). Despite all the pressures faced during that period, the government refused to cut fertilizer subsidies since it believed they needed to be kept as an encouragement to the farmers (for them to produce more maize). From 1978 up to now however, Malawi has been adversely affected by the war in Mozambique.

Recognizing the food crisis in 1988, the government increased the producer price of maize by 37 percent and then again by 44 percent in 1989, reversing pricing policies that had aimed at appreciating the relative price of export crops. This policy resulted in increased maize

production and contributed partly to a decline in per capita maize consumption. The increased maize production was partly stored due to a limited domestic effective demand and to the inability of ADMARC to find a market for its maize. This highlights a more fundamental problem. While low per capita consumption figures persist at the national level, Malawians continue to lack the income to purchase adequate quantities of maize to ensure household food security.

The year 1988/89 witnessed the official permission given to organizations and individuals who met certain criteria to obtain a license from the Ministry of Trade, Industry and Tourism to import fertilizers directly. The Smallholder Fertilizer Revolving Fund (SFRF) and ADMARC however continued to handle donor and subsidized fertilizers for the smallholder subsector. OPTICHEM continued to supply the estates, the ATC, and Smallholder Tea Authority. Because of OPTICHEM's inability to meet demand on a timely basis and because of high prices, a number of estates are importing fertilizer directly from outside the country. It should be also be recalled that floods, tremors, cyclones and an increased refugee influx all went a long way to strain the Malawian economy during the period.

1.2 AGRICULTURE IN THE ECONOMIC DEVELOPMENT OF MALAWI

Agriculture is the most important sector in the economy of Malawi as it employs the majority of the population. In 1989, it contributed 35 percent to the Gross Domestic Product (GDP) and accounted for 90 percent of the country's export earnings. The agricultural production is derived from two subsectors: estate farming and smallholder farming.

The dichotomy is essentially due to the tenurial system under which land is cultivated, the marketing system employed, and the availability of Government support.

Estate farming operates on freehold and leasehold land. Its production ranges from vertically integrated sugar operations to small tobacco estates producing one hectare of tobacco. Smallholder farming operates on customary land and under few settlement schemes on public land and ranges from subsistence-oriented agriculture to highly commercialized small farms. This subsector enjoys government support in the form of subsidized inputs, credit institutions and extension services. The market outlets for its cash crops were, until recently, controlled by the State.

In 1985, of the 4.4 million hectares available for agriculture, estate farming accounted for 14% of the land under cultivation. Smallholder farming on customary land and under settlement schemes accounted for 33% and 1% of the land under cultivation, respectively. The remaining 56% of the land was unutilized land.

Of the country's 8 million people, 90% live in the rural areas. Over 6 million of these depend on smallholder farming for their livelihood. Smallholder farming accounts for 86% of the land under cultivation and over 75% of all agricultural production. Smallholder farming provides the bulk of staple food crops (such as maize, rice, sorghum/millet, beans and other pulses, cassava, and potatoes) as well as groundnut, tea, coffee, tobacco and cotton.

Needless to say, the performance of the smallholder subsector has an enormous effect on the country's social and economic status, right

through from rural incomes and household food security to Malawi's overall food situation and growth of the Gross Domestic Product (GDP). The estate subsector is however, the principal earner of foreign exchange with its exports of tobacco, sugar, tea, tung oil, coffee and macadamia nuts. The smallholder agriculture, though, also makes a small contribution to Malawi's export earnings.

During the 1970's, Malawi's agricultural sector and the economy as a whole, displayed one of the fastest growth rates in the sub-Saharan region. The export crop sector (mainly tobacco, tea, and sugar) grew at an average annual rate of 4.1%. The main contributory factor to this high export performance was the rapid expansion of the estate subsector that benefited from a preferential policy treatment. This policy, notably characterized by differential rights to grow and sell export crops, has had a powerful adverse impact on smallholder agriculture.

Despite substantial investments in the smallholder sector by donors and the government, marketed output of most smallholder crops, with the exception of maize, has stagnated or fallen. As aggregate subsistence requirements have risen with population growth, and with increased land pressure, the area under smallholder maize has expanded. The growth in maize output, however, has been well below the growth in population; thus per capita maize production has in all likelihood declined[1].

1.3 AGRICULTURAL DEVELOPMENT POLICY AND STRATEGY

The stated Malawi Government policy objective on agricultural

[1] Lele, U (1989) - Structural Adjustment, Agricultural Development and the Poor: Lessons from the Malawian Experience. MADIA Discussion Paper No. 9. World Bank, Washington DC, USA.

development since independence, has always been "to enhance the social welfare and income of the agricultural community and the prosperity and stability of the nation as a whole by means of both improving food self-sufficiency and expanding and diversifying the agricultural export base." This has been pursued with little attention paid to Malawi's natural resource base, distribution of agricultural income, and dependence on volatile external trade. The strategies followed in the pursuit of this policy objective have covered a wide range of activities and addresses the two agricultural subsectors: estate and smallholder farming separately.

For estate farming, the central objective has been to improve foreign exchange earnings by diversifying into a wider range of commodities. This thereby reduces Malawi's vulnerability to the fluctuations in world prices for tobacco, sugar and tea, the country's principal export crops. For smallholder farming the central objective has been to: (1) equip food production with cost-effective methods and inputs and to introduce small livestock enterprises to the 35 percent of smallholders with holding sites of less than 0.7 hectare who cannot with present technology, satisfy their own subsistence requirements, and for whom off-farm income is a necessity; (2) increase food crop yields thereby releasing more land for cash crops for the 40 percent of smallholders with holding sizes between 0.7 and 1.5 hectares; and (3) intensify and diversify cash crop production by means of improved extension services, utilization of oxen, access to credit facilities, and marketing services.

At independence in 1964, Malawi inherited the more general

approach to smallholder agricultural development, which concentrated on a gradual improvement of agricultural extension, land husbandry and farmer training services. This approach was seriously handicapped by budget and personnel constraints. In the late 1960's the more capital and management intensive Integrated Rural Development Program (IRDP) was launched and served about 15 percent of the smallholder farming population in four specific areas of the country namely: Karonga - Chitipa Agricultural Development Project (KCADP) in the North, Lilongwe Land Development Program (LLDP) and Salima Lakeshore Rural Development Program (SLRDP) in the centre, and Shire Valley Agricultural Development Project (SVADP) in the South of the country.

In the integrated effort various agricultural services were supported by complementary measures in the field of infrastructure such as roads, health, water supplies, marketing and input supplies, and others. This emphasis on the Integrated Rural Development Program (IRDP) was sort of a big push on a small scale whereby poverty would be attacked and constraints to development removed on many fronts. Organizing all these investments under one Management Unit (MU) was considered necessary to ensure proper coordination of effort, but was dictated by the inability of other Ministries and Development Agencies of the Government to plan and carry out their own projects in rural areas.

Because of budget and manpower constraints, it was realized that such intensive and costly capital investments could not be replicated in the rest of the country within a reasonably short period of time. A rethinking of the strategy resulted in the National Rural Development

Program (NRDP) concept. This concept, aimed at providing agricultural services more extensively on a replicable basis, covers the whole country over a 20-year period giving initial priority to high potential areas. The Program was launched in 1978 with a detailed resource inventory, in which the country was divided into 8 Agricultural Development Divisions (ADD), 40 Rural Development Projects (RDPs) and 180 Extension Planning Areas (EPAs)--each with about 5,000 farming households at the time. Utilizing this inventory, a phased Program of development was drawn up in which various donor agencies have been providing financial support.

NRDP aims were to: (1) raise living standards and improve the overall social conditions of the rural people; (2) obtain national self-sufficiency in basic foods and other agricultural products; (3) ensure better nutritional status for the rural people with particular emphasis on the nutritionally vulnerable groups; (4) increase the production of cash crops for export and for the country's agro-industries; (5) improve the efficiency of smallholder agricultural production with particular emphasis on productivity per unit area; (6) improve the distribution of farm inputs, food and other agricultural products; (7) encourage the integration of livestock into the smallholder farming systems in order to meet the national demand for animal protein; (8) provide sufficient price incentives to smallholders in order to encourage them to increase agricultural production; (9) preserve the natural resources of the country by encouraging high standards of crop husbandry combined with soil conservation, rehabilitation of degraded areas and afforestation.

At the time the NRDP was being launched, Malawi started to ex-

perience severe economic constraints caused by external shocks and domestic imbalances. The external shocks were primarily due to falling prices of exports, rising oil prices and disruption of transport routes through Mozambique. The domestic structural imbalances were mainly attributed to deficit spending initiated to sustain aggregate demand and later to finance growing expenditures related to the deteriorating regional security situation and assistance for refugees from Mozambique who currently number about one million. These external and internal shocks were exacerbated by the estate's crisis caused by some weaknesses which included management problems among other things (World Bank, 1990).

To address the eroding economic performance resulting from these problems, the country embarked on the "Structural Adjustment Program" (SAP) which was launched in 1981. It was designed to improve the balance of payments, cut the budget deficit and give the market mechanisms greater influence in determining prices, wages, resource allocation, and the structure of production. This involved, among other measures, phased elimination of fertilizer subsidies; increases in smallholder producer prices; elimination of consumer price subsidies; exchange and interest rate adjustments; high fees for public utilities and services; cuts in public expenditure; shifts away from the NRDP towards agricultural research and extension, with the complementary investments under NRDP reverting to their respective line Ministries and Departments of Government who now plan and carry out their own national program or rural development; and restructuring of the Agricultural Development and Marketing Corporation (ADMARC) which involved market

liberalization for smallholder grain crops.

The economic history of Malawi, like that of the rest of Sub-Saharan Africa, shows that price-related policies have been the main policy instruments used to affect economic changes during the last three decades. The Malawi Government has been determining smallholder farm input and producer prices, as well as food prices, for consumers based on recommendations by the Pricing Commission. The Pricing Commission includes representatives of the Ministry of Agriculture (MOA), the Department of Economic Planning and Development (EP&D), and ADMARC. The main criteria for determining prices has been to ensure that smallholder farmers cover their costs of production and ADMARC obtains a reasonable profit. Since the 1982/83 cropping season, the Government has developed, with the assistance of World Bank, a pricing system. This pricing system considers export and input prices, along with other factors such as the desire for food self-sufficiency, consumption effects, ADMARC profit, Government revenue, income effects and foreign exchange effects. Thus, the current agricultural pricing policy reforms have been adopted to stabilize and to improve the structure of the economy.

The first aspect seeks to achieve a rapid return to broad equilibria by reducing the overall expenditure through budget and monetary restrictions. The latter aspect aims at increasing the competitiveness of the exportable and importable goods through an increase in the price of such tradables--in other words, an improvement in the real exchange rate. Since smallholder farming in Malawi produces a substantial share of tradables, these policies are intended to benefit the smallholder farming subsector. These Government-determined prices

reforms on non-price factors such as accessibility to farm credit, encouragement of local entrepreneurs through the provision of conditions for free entry into markets to support commodity markets, and creation of adequate infrastructure for efficient movement of goods.

The study is organized into two major sections. The first section evaluates the effects of policy reforms on Malawi's food security and export diversification goals, which were to be achieved through the widespread use of fertilizers, improved seed and other modern inputs. The study goes on to assess the effects of the policy reforms on the use of these inputs. The second section examines the effects of the policy reforms on the determinants of fertilizer use. More specifically, the section analyzes the change in fertilizer returns, fertilizer credit, and delivery and other factors. The section also deals with farmers' response in terms of fertilizer demand and concludes the whole study with policy recommendations.

Finally, data used in this study consist primarily of secondary data. It should be stressed that this data is limited. Most data were however, taken from reports based on the Annual Surveys of Agriculture (ASA) and data of the National Statistics Office (NSO).

have generally been set on a uniform national basis so that ADMARC sales of farm inputs and food products, and purchases of farm produce are set at a price that does not vary with the distance from the final market. As a result of SAP, the Government has continued to review and adjust input, producer and food prices annually. It is, therefore, pertinent in this study to examine the extent to which the policy reforms under SAP, have helped Malawi to achieve its agricultural development goals.

1.4 OBJECTIVES, PLAN OF THE STUDY, AND DATA SOURCES

As has been noted above, a sustained rapid growth in the consumption of fertilizer, improved seed, and other modern inputs was seen by policy-makers as essential for the improvement of the productivity of Malawi's smallholder agriculture, particularly the production of food crops to sustain self-sufficiency and the expansion of the cash crop base for export diversification. In this regard, the study concentrates on the difficulties Malawi experiences in achieving its agricultural goals through a widespread use of fertilizers and other improved inputs. More precisely, the study focuses on a number of aspects pertaining to the use of fertilizers and other productivity-improving inputs, and relates these aspects to policy reforms initiated in the context of the structural adjustment program.

Ultimately the study seeks to propose appropriate policy and institutional reforms required to improve agricultural productivity within the smallholder farming subsector. This can be accomplished through increases in crop response to fertilizer and other input use, reduction in input prices, increases in producer prices, as well as

CHAPTER 2

FOOD SECURITY IN MALAWI

As noted above, the economic history clearly shows that since independence, the Malawian Government has pursued two related objectives: food self-sufficiency and export crop diversification. In an effort to achieve these goals, policymakers have used over the years, different policies and strategies. Among these policies and strategies, policy reforms implemented since 1981 in the context of the structural adjustment program, have been extensive and most challenging to policy makers. This is not only in Malawi but elsewhere in Africa, where a similar package of policy reforms were adopted. This chapter assesses whether these policy reforms have had a positive or negative impact on Malawi's national food security.

2.1 CONCEPTS AND DEFINITION OF NATIONAL FOOD SECURITY

In Malawi, food security has often been interpreted as national food self-sufficiency with regard to maize, the main staple food in the country. Though a widely debated and much-confused issue, food security is basically defined as access by all people, at all times to the food needed for a healthy life. The food security concept addresses people's risks of not having access to the required food. Access to food, availability of food, and risks related to either access or availability

are the essential determinants of food security. A policy is considered efficient when it reaches this goal at the least cost and is sustainable in the long run[2].

In 1987-88, Malawi had to import 140,000 tons of maize, while at the end of the 1990 marketing, year the national stock was almost depleted[3]. The policy objective has been to generate a surplus of maize that meets the total effective demand at national level. This concept is quite narrow. The first shortcoming of this concept is that national food security is not generally understood in terms of food self-sufficiency, but in terms of a country's ability to acquire food in order to meet its effective food demand.

This definition implies that a country can meet its effective food demand either through its own food production, through food import, or through the combination of both. Here the concept of national food security is that of food self-reliance at the country level. The country is to find a balance on the basis of its comparative advantage between crop production for domestic consumption and for export, since export earnings are also needed to partly finance food imports, as well as food production.

Secondly, limiting the national food self-sufficiency to one food crop -- e.g. maize -- appears not to reflect the reality, because the weight of all the minor crops that enter the country's food basket cannot be ignored. In addition, maize can not be considered to perform

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[2]Von Braun, J. et al. 1992. Improving Food Security of the Poor: Concept, Policy, and Programs. International Food Policy Research Institute, Washington, DC.

[3]Sijm, J., 1990. Food Security and Policy Interventions in Malawi, Tinbergen Institute/Centre for Development Planning. Erasmus University Rotterdam, p 3.

well in all the agro-ecological zones of the country. By focusing only on maize among food crops, the country appears to miss out because it does not take into account the comparative advantage of each agro-ecological zone. Furthermore, the country is making its food base very narrow and vulnerable to an outbreak of maize diseases, pests, or any other natural calamity.

Other shortcomings of the Malawian definition and concept of national food security are that even when a consideration is made of only maize, it is the maize purchases made by ADMARC that is considered. It must be noted however, that apart from some small amounts being marketed by local and private traders, the major part of the maize harvest is used for household subsistence consumption.

Another shortcoming in interpreting food security in terms of production, marketing and consumption of maize, is that it ignores the possible role of other food crops (and animal products such as fish). Although maize is the major food crop, in some parts of the country people mainly rely on either cassava (Lake Shore) or rice (Karonga, Lower Shire Valley), for their daily caloric needs. Groundnuts, pulses and, in some places, fish add significant quantities of energy and protein to the local diet.

In addition, yet another shortcoming to equating food security with a sufficient marketed surplus of maize at the national level is that such a surplus does not guarantee food security at the regional and household level. Moreover, this also has serious implications for diet and consequently, for the country's nutritional status. In fact, Malawi is among the developing countries with a high level of malnutrition. Inadequate food supply and the nature of diet are among the 5 causes of

malnutrition identified in Malawi (World Bank, 1990). Malawi is among the countries with a very low level of average food consumption (J. Von Braun et al, 1992).

To fully meet 75 percent of the WHO caloric norm for an estimated population of 8.5 million (1989-90), a total production of 1.86 million tons of maize is required. Even in a year with a bumper crop available, this leaves Malawi with a national maize deficit of some 350,000 tons[4]. The average food energy consumption in 1989 was below 2,100 kilo calories per capita (World Bank 1991). With 75% of the national caloric requirements coming from maize, and with the present population, an average consumption of 180 kg per head per year is necessary to meet WHO estimates of caloric needs (Von Braun et al 1992). The current national diet in Malawi is maize-based. Maize, a comparatively new part of the diet, has progressively displaced the traditional food staples of millet, sorghum, and cassava. Although, more difficult to prepare and less attractive to consume, these traditional staple crops are less vulnerable to drought.

2.2 HISTORY OF FOOD SECURITY IN MALAWI

Malawi, since independence, has made remarkable strides in coping with the problems of self-sufficiency in food production, compared to many of Malawi's more prosperous (or potentially more prosperous) neighbors. Hence, many of the policies and programs are worthy of examination. Although the smallholder subsector is not adequately compensated for their produce, Malawi is nevertheless one of the few

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[4]World Bank. 1988 Malawi-Agricultural Marketing and Estate Development Project, Staff Appraisal Report No. 7401 Mai, Washington, D.C.

African states that has permitted the adjustment of food prices, particularly maize, to favor the interest of the rural producer rather than allowing prices to subsidize the food purchases of the more politically volatile urban minority[5].

As regards to land availability, it is to be noted that with an estimated population of about 8.5 million people in 1990 and a total land size of 9.4 million hectares, population density in Malawi averages 90 persons per square kilometer. Depending on the assumptions with regard to the suitability of land for agriculture, estimates of available arable land per capita in 1981 range from 0.46 to 0.67 hectares[6]. Due to a high rate of population growth, at least 3.2 percent a year, these figures will decline even further ranging from 0.30 to 0.46 hectare of available arable land per capita in the year 2000. The pressure on land is reflected in the small size of agricultural holdings in Malawi. Land pressure is most intense in the southern region where population density is far higher than in the central or northern region of the country. For instance, in the densely populated Mulanje District, a majority of households in a sample of six villages had access to less than 0.4 hectare of land. As a result, most of the people surveyed identified insufficient landholdings as the main constraint to satisfying subsistence requirements[7]. Although, there still seems to be some arable land available, especially in the northern

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[5]Bates, R. H. 1981. Markets and States in Tropical Africa: The Political Basis of Agricultural Policies, Berkeley: University of California Press.

[6]Lele U., and W. Stone (1989) Population pressure, the environment and agricultural intensification: variations on the Boserup hypotheses MADIA paper, World Bank, Washington, D.C.

[7]Trivedy, R., (1988) Investigating Poverty Action Research in Southern Malawi, Oxfarm research papers.

region, with a dwindling land reserve per capita (giving the rapid rate of population growth) the percentage of farm households who cultivate less than one hectare is expected to increase substantially in the near future. With the present state of technology, an average household of 4 to 5 persons needs about one hectare to meet its maize requirements[8].

Pricing policy reforms have resulted in serious food security implications. In particular, increasing net maize exports from 1982 to 1985 followed by decreasing maize production from 1985 to 1987 have contributed to continuously low levels of national per capita consumption over the adjustment period. In contrast to an average per capita maize food consumption of 206.5 kg during the pre-adjustment period of 1976/77 - 1979/80, per capita consumption had fallen to an average level of 166.0 kg during the post adjustment period of 1982/83 - 1986/87[9].

Since independence, one of the priorities of the agricultural development strategy was to increase the productivity of smallholder farmers by improving their farming techniques. One method was to benefit a select group of progressive farmers who were supposed to act as model farmers in order to motivate other peasants to copy their farming practices. It is unfortunate to observe that this trickle-down strategy was not effective[10]. Another method of improving the productivity in the smallholder sector was the introduction of large Integrated Rural Development Projects in the late sixties. These IRDPs

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[8]Sijm J. July 1990. Food Security and Policy Interventions in Malawi. pg 13, 14. Tinbergen Institute Centre for Development Planning. Erasmus University Rotterdam.

[9]Sahn, E. D., 1990. The Stagnation of Smallholder agriculture in Malawi: a decade of structural adjustment. Cornell University. Food and Nutrition Policy Program, Washington DC.

[10]Ngalande Banda, E. E., 1989. Malawi Smallholder and Estate Farm Interactions: An Economic Policy Simulation Model, Ph. D. Dissertation. Boston University Graduate School.

provided smallholders with a comprehensive package of services and socioeconomic infrastructure in four designated areas. In the seventies these expensive and management intensive projects were mainly supported by the World Bank and other foreign donors. Compared to other experiences in sub-Saharan Africa, the implementation of the IRDPs in Malawi was relatively good. However, in terms of improving smallholder production they were disappointing[11].

After IRDP, the NRDP was instituted. A World Bank review concluded that the NRDP had assisted a minority of farmers with above average land resources, but has so far had little impact on the majority of resources of poor smallholders who may be regarded as food insecure[12]. The average annual growth of smallholder production between 1982 and 1989 was about 2.9 percent, an improvement compared to its pre-1982 level but still less than the annual rate of population growth. As a result, the per capita peasant output has continued to decline in the eighties[13]. Most smallholders, however, grow maize mainly for home consumption. Since 1987 price changes have shown a repetition of the trends in the early 1980s and a reversal of the trend in the mid-1980s. A combination of factors (adverse weather, mealy bug pest, low maize prices, influx of refugees from Mozambique, market liberalization) dramatically changed the balance between ADMARC's purchases and sales of maize in 1987. This resulted in a threat to national food self-

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[11]Kydd J. G., and N. J. Spooner (1986) The World Bank's analysis Malawian agriculture : changing perspectives 1966 to 1985, World Bank, Washington, D.C.

[12]Carr J. S. 1988. Malawi - National Rural Development Program (NRDP) Technical issues review, draft white cover, August 23, 1988 the World Bank, Washington D.C.

[13]Malawi government (1989). Economic Project 1989. Office of the President and Cabinet, Department of economic planning and Development, Budget document No. 4. Government Printer Zomba, Malawi.

sufficiency and massive maize imports.

In response, the government increased both nominal and real ADMARC's purchasing prices of maize, while the relative and real prices of export (cotton, groundnut) crops were reduced. Increased producer price of maize resulted in a large increase of peasant maize sales to ADMARC and a decline in ADMARC's purchases of export crops especially groundnuts. Yet, the output per hectare for peasant crops have remained almost stagnant since 1980, implying that as far as output growth has occurred, it has been achieved through expansion of cultivation into the few remaining uncultivated land areas[14].

Malawi's attempt at solving her food security problem continues to be approached with production-oriented policies and programs. Other possible solutions are used elsewhere, such as (i) storage and trade-oriented policies for stabilization, (ii) labor intensive public works, (iii) macroeconomic policy and development strategies, (iv) targeted feeding, food stamps, and food subsidies, and (v) emergency relief programs. It is important to note that production-oriented policies and programs adopted by Malawi, can improve food security if they increase or stabilize the real income of the food-insecure people.

Technological innovation and commercialization of agriculture help to alleviate poverty and improve food security by stimulating agricultural growth, improving employment opportunities and expanding food supplies. Gains in real income lead to improvement in food consumption and nutritional welfare. Agricultural growth further enhances food

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[14]Christiansen R. E., and Southworth (1988), Agricultural Pricing and Marketing Policy in Malawi: Implications for a development strategy. Paper presented at the Symposium on agricultural Development Policies for Growth and Development, Mangochi, Malawi, October 31 - November 4, 1988.

security by stimulating, through multiplier effects, non-agricultural employment and income.

Agricultural growth also improves food security by permitting household assets to grow, thus reducing the vulnerability of households to short-term disruptions in their income streams. Rural financial markets need to develop rapidly along with agricultural growth, to enable households to build up their productive asset base[15] [16].

From 1986, the conditions for ensuring national food security changed drastically. This was attributed mainly to the influx of more than 250,000 refugees from Mozambique in the late 1980s. Although, at present, food requirements of refugees are met by food aid of international relief organizations, they restrict the capacity to import maize for the Malawian people during periods of production shortfalls.

Based on this new situation, the food security and nutrition unit (office of the President and Cabinet) has estimated that in-country buffer stocks of 145,000 tons were needed to guarantee national food security in the marketing year 1988/89. Due to population growth, this minimum stock level is estimated to increase by about 46,000 tons each year unless there is a structurally higher level of maize production, a reduction in refugee import needs, a significant expansion in transportation capacity, or an improved early warning system put into place[17].

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[15] World Bank, 1990 - Malawi Food Security Report No. 8151 - Mai, Washington DC.

[16] Von Braun, J., Bouis, H., Kumar, S., Pandya-Lordy, R. 1992. Improving food security of the Poor. Concept. Policy and Programs, P 1-3. International Food Policy Research Institute, Washington, D.C.

[17] Mann, C. H., Mapondo, and J. Mhango, 1988. Food security Policy, Including the Role of ADMARC in Price Stabilization, Paper presented at the Symposium on Agricultural Policies for Growth and Development Mangochi, Malawi, October 31 - November 4, 1988.

Since the government has realized the serious nutritional needs of its people, it has developed some specific programs to improve the nutritional status of vulnerable groups. Through the fives' clinics, a major feeding program was implemented. This program aims at giving supplementary food to children judged to be at risk, according to their recent growth pattern, their weight for age and clinical observations. It is observed however, that the clinic and community based feeding programs are aimed at treating malnutrition rather than preventing it[18].

Although improving food availability may be the most dominant factor of Malawi's nutrition problem today, in addition to increasing household food production and the productivity of agricultural labor, other strategies are necessary to reduce malnutrition and food insecurity. Among these strategies, expanding the opportunity for income-generating activities will have strong and long-lasting impact.

We conclude this historical review by saying that although the structural adjustment programs have contributed to restoring macroeconomic balances in the 1980s, the results of the price and marketing reforms in the smallholder subsector have been disappointing, especially with regard to raising smallholder productivity and reducing their food insecurity. Apart from adverse external conditions and population growth, an important reason for this poor performance is that the structural adjustment programs did not deal with the real structural constraints to improving the living conditions for the majority of smallholders in Malawi. The disappointing total output response to

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[18]Msukwa, L. A. H. 1986). "Nutrition strategies in Malawi" in: Rukuni, M., G. Mudimu, and T. S. Jayne, eds (1990) Food Security Policies in the SADCC Region, University of Zimbabwe, Harare, pp 253-262.

price policy reform, as it will be shown in the subsequent chapters of this study, can be explained by the high prevalence of subsistence farming in Malawi, and by the fact that non-price factors rather than prices, appear to be the most binding constraints to raising agricultural productivity. These non-price factors include land and labor constraints, lack of access to appropriate technologies, improved inputs and agricultural services, restrictions on growing high-value cash crops, as well as the unreliability of the marketing system[19].

2.3 ASSESSING THE CHANGE IN MALAWI'S FOOD SECURITY

The strategy used by the government of Malawi in the context of the structural adjustment program was aimed at improving the country's food self-sufficiency and achieving export crop diversification through the reallocation of land in favor of export crops, the use of fertilizers, improved maize varieties and pesticides. This yield-increasing, land-saving technology was expected to result in increased maize output in such a way that the national food security was to improve. In this analysis therefore, we will check: (1) whether the land under maize cultivation was decreasing over the period of study, (2) whether the yield of maize was significantly increasing, (3) whether the output of other non-maize crops combined was also increasing.

Data on these points of consideration are given in Table 2.1 - 2.3. When one looks at the rate of change in land area under various crops, (Table 2.1) during the 1971-87 period one realizes that the area under food and minor export crops was declining at an average rate of

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[19]Sijm, J., Food Security and Policy Interventions in Malawi Tinbergen Institute/centre for Development Planning Erasmus University Rotterdam, July, 1990, p. 111.

0.2 percent per annum during the period. The area under major export crops was, on the contrary, expanding at the annual rate of 1.1 percent during the same period. This data confirms that land reallocation was achieved at the expense of food and minor export crops. The major export crops including tobacco, sugar, tea, cotton, and groundnut continued to expand during the period.

A further disaggregation of the area under food and minor export crops into area under maize and other crops (Table 2.1) shows that the area under maize was increasing during the period at an average annual rate of 0.6 percent, instead of decreasing as expected. The area under other food and minor export crops was declining at an average annual rate of 0.4 percent instead of increasing as expected from policy reforms. In summary, the bulk of cultivated land resources in the country continues to be under maize and major export crops.

In a division of the period of study into three subperiods -- 1971-78, 1979-83 and 1984-87 -- corresponding to major economic policy events and reforms (described in chapter 1) one can see that it was only during the 1984-87 subperiod that the area allocated to maize declined by a mere average annual rate of about 0.1 percent. It is worthwhile noting that during this subperiod the producer price of maize relative to fertilizers was reduced compared to producer prices of competing crops. This pricing policy was initiated in order to promote export crop diversification. The area under major export crops increased at an average annual rate of 0.6 percent, while the area under other food and minor export crops declined at an average annual rate of 1.5 percent during the 1984-87 subperiod.

It is clear that policy reforms initiated in 1981 did little to

help Malawi alter its land use pattern in favor of crops other than maize and major export crops in order to achieve both food security and export crop diversification. The analysis of observed trend in maize yield during the period further confirms that the policy reforms did little to help Malawi improve its food security. On a yearly basis, Table 2.2 indicates that the annual growth rate of maize yield were, for the most part of the 1971-88[20] period, negative. During the 1971-78 subperiod, the maize yield increased at an average annual rate of about 2.1 percent. This growth rate of maize yield combined with the observed 0.9 percent growth rate of area under maize, fell short of the population growth rate of about 3.2 percent per annum. This implies that even during this subperiod characterized by both maize yield growth and expansion in maize area, the per capita maize output, declined at an average annual rate of about 0.2 percent.

The maize production continued to deteriorate during the pre-adjustment subperiod. Maize yield was declining at an average annual rate of about 1.9 percent whereas the area under this staple food crop was increasing at a very modest average rate of about 0.7 percent per annum during the 1979-83 period. Compared to the annual population growth rate, this translated into a 4.4 percent decline in per capita maize production per year during this pre-adjustment subperiod. The production of maize did not improve during the post-adjustment subperiod as maize production per capita continued to fall. Maize yield was decreasing at an average annual rate of about 1.5 percent. This decline in maize yield was accompanied by a contraction of cultivated maize area

[20] These rates were computed using a three-year moving average method in order to account for changes in rainfall and other climatic conditions.

at the rate of 0.1 percent per annum during the subperiod. This resulted in a 4.8 percent decline in per capita maize output per year during this subperiod.

The deterioration of the maize production was further compounded during the entire period by a significant contraction of land area allocated to other food crops and minor export crops, all of which fell under smallholder farming. These other food crops attract little or no fertilizers as they are primarily subsistence-oriented. This remains true, to some extent, even for local maize primarily used by farming household for home consumption. Their yields must have declined during the period as most of these minor food crops tend to be cropped on poor land and the fallow system tends to disappear as a result of population pressures on land.

The observed expansion of the agricultural export sector did not lead to an improvement in income distribution between capital and labor owners. Instead this expansion of the agricultural export sector resulted in a very skewed income distribution in favor of capital owners. Table 2.3 shows that during the 1979-83 subperiod the index of the real agricultural (rural) wage was 112.4. This index was reduced to 76.3 during the 1984-88 subperiod. Policy reforms have resulted in a reduction of real agricultural (rural) wage--the income of most people in Malawi. This situation must have led to a fall in the effective demand for food by most rural people in Malawi during the (post-adjustment) 1984-88 subperiod.

Malawi has to go beyond just getting prices right. For a real structural adjustment, in addition to pricing policy, focus must also be on structural and institutional weaknesses that constrain smallholder

agriculture and contribute to widespread food insecurity and malnutrition. The pricing policy reforms have led to a contraction of the food sector as indicated by a negative growth rate in per capita maize and other food crop output. Adjustment in Malawi, therefore, must be more oriented to supply expansion than demand contraction with particular emphasis placed on promoting agricultural growth in the smallholder subsector.

TABLE 2.1 GROWTH RATE OF AREA UNDER EXPORT AND FOOD CROPS

Year	Major export crops (percent)	Food crops including minor export crops (percent)	Maize (percent)	Other food crops & minor export crops (percent)
1970	-	-	-	-
1971	8.9	-1.6	2.7	-7.0
1972	-2.3	-0.5	1.8	-1.7
1973	-4.2	0.8	2.4	-1.5
1974	1.9	-0.4	-3.5	4.5
1975	-5.5	1.1	-10.4	17.3
1976	4.5	-0.9	0.0	-1.7
1977	5.0	-1.0	0.0	-2.0
1978	0.6	-0.1	13.9	-15.8
1979	0.6	-0.1	1.0	-1.8
1980	-4.7	1.0	-16.4	29.3
1981	1.8	-0.4	13.4	-14.1
1982	0.0	0.0	8.4	-11.1
1983	10.8	-2.2	-2.9	0.9
1984	1.1	-0.2	0.2	-0.9
1985	3.8	-0.9	-3.6	3.5
1986	-3.1	0.7	4.1	-4.3
1987	-1.1	0.2	-0.1	1.9
1970/78	1.1	-0.2	0.9	-9.9
1979/83	1.7	-0.3	0.7	-2.8
1984/87	0.6	-0.2	-0.1	-1.56
1970/87	1.1	-0.2	0.6	-0.4

Source: FAO, 1990. Food Balance Sheet Tape Yearbook.

TABLE 2.2 MAIZE YIELD

Year	Observed maize yield (kg/ha)	3-year moving averages of maize yield (kg/ha)	Growth rate of maize based on moving average (percent)
1970	900.0	-	-
1971	1180.2	1090.4	-
1972	1190.9	1161.9	6.6
1973	1114.6	1152.9	-0.8
1974	1153.2	1089.3	-5.6
1975	1000.0	1083.7	-0.5
1976	1098.0	1139.7	5.2
1977	1321.0	1218.8	6.9
1978	1237.4	1252.7	2.8
1979	1199.8	1220.1	-2.6
1980	1223.1	1184.9	-2.9
1981	1131.8	1178.1	-0.6
1982	1179.2	1160.6	-1.5
1983	1171.0	1180.4	-1.7
1984	1191.1	1181.8	-0.1
1985	1183.5	1153.2	-2.4
1986	1084.9	1094.9	-5.1
1987	1016.4	1092.9	-0.2
1988	1177.3	1096.9	0.4
1970-78	1148.7	1148.7	2.1
1979-83	1187.8	1184.8	-1.9
1984-88	1125.9	1124.0	-1.5
1970-88	1144.9	1151.8	0.1

Source: FAO, 1990. Food Balance Sheet Tape Yearbook.

Note: All maize varieties combined.

TABLE 2.3 REAL AGRICULTURAL (RURAL) WAGE IN MALAWI

Year	Real Wage Index (1980 = 100)	Rate of Change (percent)
1977	110.5	-
1978	119.3	8.0
1979	106.4	-10.8
1980	100.0	-6.0
1981	108.5	8.5
1982	129.6	19.5
1983	100.9	-22.1
1984	89.1	-11.7
1985	89.8	0.8
1986	78.8	-12.2
1987	69.3	-12.0
1988	54.3	-21.7
1977/83	112.4	3.8
1984/88	76.3	-11.4
1977/88	96.4	-5.4

Source: International Labor Office (ILO), 1987. 1991 Yearbook of Labor Statistics, Geneva.

CHAPTER 3

EXPORT CROP DIVERSIFICATION PROGRAM

Malawi experienced remarkable growth during the 1960s and 1970s. This was due to its agricultural export strategy in the fields of the traditional export crops of tobacco, sugar and tea. Fluctuations coupled with persistent falls in the price of agricultural export crops, which are happening as a result of the inelastic demand for agricultural commodities on the international market, have caused Malawi, just like many agrarian economies, to resort to broadening their export base in order to ensure less shocks to their balance of trade. It is therefore worth analyzing the impact of policy reforms on the agricultural export diversification program pursued by the Malawian government. This analysis is called for, not only because of the current prominence of agricultural export strategies in the recommendations of multilateral aid agencies, but also because of the fact that agricultural export diversification and food security in Malawi are intertwined.

3.1 BACKGROUND ISSUES

Market prospects for the three major exports, tobacco, sugar and tea, which contribute 80% of the total exports with tobacco accounting for almost two-thirds of all merchandise exports have not been good. In

an attempt to diversify the export base of the country, more attention was to be given to other crops such as groundnut, seed cotton, coffee and macadamia nut. The contribution of the agricultural sector as a whole to export earnings is about 90 percent and Malawi has had to rely on this sector to achieve growth.

Malawi has done quite well in terms of growth of export crop production. Its strong export growth has diverted attention from an examination of the basic structural constraints to increased smallholder production, as well as attention to technological constraints that have adversely affected smallholder performance[24]. Malawi's growth record was good in the 1970s, primarily reflecting its good macroeconomic policies. Land and price policies swamped the effects of other favorable policies in smallholder agriculture. The emphasis on a "quick" poverty alleviation during the 1970s gave priority to helping low income regions and populations, and to raising food crop production. The present tendency to emphasize equally "quick" solutions based on correction of price incentives and markets, can lead to inadequate attention paid to an appropriate balance between short-term macro-policy adjustments and long-term capacity building[25].

Between 1965 and 1979, agricultural exports grew at an average rate of 6.8 percent per annum and food imports were minimal[26].

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[24]Lele, U., Meyers and L. Richard (1989). Growth and structural change in East Africa Domestic Policies, Agricultural performance Part 1, World Bank, Washington, D.C.

[25]Lele, Uma 1989 "Agricultural Growth Domestic Policies, the External Environment, and Assistance to Africa MADIA discussion Paper 1.

[26]Sijm, J., 1990. Food Security and Policy Interventions in Malawi. Tinbergen Institute/Center for Development Planning. Erasmus University Rotterdam.

Agarwala[27] associated Malawi's high agricultural export growth figures with the low level of export crop producer price distortion.

Starting from 1979, Malawi had to cope with serious economic difficulties due to a combination of adverse world economic conditions, structural weaknesses in the national economy and deficient government policies. The adverse world economic conditions included falling international prices of Malawi's main export products, higher import prices and rising interest rates on foreign commercial loans. In addition, the political troubles in Mozambique led to a disruption and eventually to a virtual closing of Malawi's most important external transport routes through the ports of Beira and Nacala. Of the factors underlying the structural weaknesses of the national economy and inadequate government policies, one can identify: (1) stagnation of the smallholder sector, especially of peasant export production, (2) the narrow export base, implying a high dependence on the export earnings of only a few agricultural commodities (tobacco, tea, and sugar), and (3) a deterioration of the financial performance and efficiency of parastatals such as ADMARC.

The government of Malawi has pursued two different set of policy measures: one applied to estate sector; and another applied to the smallholder sector. The estate sector has the permission to grow burley and flue-cured tobacco varieties, while smallholders are allowed to cultivate darkfired, sun/air-cured, and oriental tobaccos as well as cotton. In addition, tea, sugar, and coffee are predominantly produced

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[27]Agarwala, R. (1984), "Price Distributions and Growth. A Study of the Association in Developing countries, Finance and Development, Vol 21, pp 33-37.

by estates, while groundnut and hybrid maize are mainly cultivated by smallholders, as additional sources of cash incomes. Smallholders are required to sell their tobacco and cotton production to ADMARC at government-determined prices, whereas estates are free to sell their output at auction prices determined on the world market[28].

As a partial result of this differential policy treatment, estate production of tobacco increased more than six times between 1969 and 1979, implying an average annual growth of 20 percent. Tea production by the estates almost doubled in this period, at a mean annual rate of increase of 6.8 percent. Large-scale production of sugar started in the mid-60's and grew almost 15 percent per annum during the 1969-79 period. Policymakers, their associates and a few expatriates gave the estate sector their personal attention and investment. By 1985, the number of estates had increased to about 4000 of which more than 3000 predominantly grew tobacco and almost 500 mainly cultivated the flue-cured variety[29]. Although some of the estates are very large (more than 1000 hectares), the majority of the burley estates are less than 5 hectares[30]. ADMARC and the Commercial Banks invested a lot of their capital in the estates to the neglect of the smallholder sector and labor was transferred from the smallholder to the estate subsector. The wage laborers on tobacco estates for example increased from 8000 in 1969

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[28] Lele, U., and M. Agarwal (1989) Smallholder and large-scale agriculture in Africa: Are there trade-offs between growth and equity? MADIA Working Paper, World Bank, Washington, D.C.

[29] Malawi government (1988). Statement of development policies (1987-96) dept of economic planning and development government printer Zamba.

[30] Malawi government (1988). Statement of development policies (1987-96) Dept of economic planning and development government printer Zamba.

to 88,000 in 1978[31].

During these periods, there was a deterioration of the socioeconomic conditions of the smallholder sector. The impoverishment of this sector was caused by several factors, such as the taxation of the smallholder cash crops, the stagnation and deterioration of productivity, and the population growth consequently causing increased land pressure. A strong factor that has worked against the smallholder sector is the regulation of tobacco production. Malawi's exports, especially burley tobacco, is large enough to influence its price on the world market. The production restriction via licenses or quota raises international burley prices and therefore, creates economic rents which accrue to those estate owners who hold a license. Burley tobacco, however would be an ideal high-value cash crop for smallholders because it is relatively easy and cheap to grow[32]. In addition, it has been shown that of all potential smallholder cash crops, growing burley would offer the highest returns per unit land area[33]. Therefore, the allocation of a small part of the farm holding to burley tobacco would enable a peasant household to grow some other new export crops. Attempts of peasant farmers at growing burley tobacco has been resisted on the argument that they may cause a lowering of the price due to poor quality production. However, the rapid turnover of burley tenants

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[31]Ngalande Banda, E. E., (1989) Malawi Smallholder and Estate Farm interactions: An Econometric Policy stimulation model, Ph.D. dissertation, Boston University.

[32]Sijm, J. 1990 July. Food Security and Policy Interventions in Malawi. Tinbergen Institute/Center for Development Planning, Erasmus University, Rotterdam.

[33]Carr, S. J. (1988). Malawi-National Rural Development Program (NRDP) - Technical Issues Review, Draft White cover, August 23, 1988. The World Bank, Washington, D.C.

implies that there are large numbers of peasants with the basic experience needed to grow high-quality tobacco[34].

During the 1970s, ADMARC like many other marketing boards in Africa used to extract income from the smallholder sector in favor of the estate sector. The smallholder production of cash crops such as tobacco, cotton and groundnuts was taxed and the proceeds were largely invested in the estate sector. This led to some of the structural problems of the national economy; for example, the stagnation and impoverishment of the smallholder sector. For all the crops, including maize, ADMARC is obliged to purchase all quantities offered at guaranteed minimum prices. Producer prices were announced well before the planting season and were held constant over the whole year. In order to ensure regional equity, the same price was offered by ADMARC at all its markets, no matter the cost of transport. It is also clear that the profits ADMARC made on export crops were realized by paying prices to smallholders far below the comparative export parity or domestic auction floor prices. The estate sector sold and continues to sell its produce at the auction prices.

It is impressive to note that in the face of the treatment the smallholders had from ADMARC, foreign donors were investing millions of Kwachas in the peasant subsector via rural development programs. The rate of return of this sector would not probably have been low if ADMARC's trading profits had been invested in the smallholder subsector.

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[34] World Bank Malawi, Land Policy Study, Report No. 6747 MAI, April 24, 1987; Washington, D.C.

3.2 EXPORT DIVERSIFICATION: OBJECTIVES AND CONCEPT

Diversification has several objectives. The primary concern, perhaps, is the avoidance of the fate which has befallen most post-colonial states--namely, the dependence of the national economy upon relatively few export crops or minerals for economic survival. Under the colonial system, it made sense from the perspective of the imperial power to encourage territorial specialization and thereby reduce inter-colony competition. When any of these countries got its independence, they immediately became a competitor in the open world market and came into the painful realization that the prices for its basic commodities were being set at the global level by the industrial consumer nations.

Many countries drew their development plans based on the incomes derived from their export crops. They found that all their projections were rendered questionable since the export revenue foundation, on which they stood, began to crumble and to experience fluctuations. The fluctuations experienced in export revenue were due to varied reasons ranging from new competitive producers of the same goods, a recession or depression in the consumer nations and the development of synthetic and other substitutes. Diversification therefore, constitutes a hedge against these fluctuations in export revenue.

Crop diversification, especially when it is tied to the creation of processing plants, has wider implications, of course, than hedging against global price fluctuations. It provides new sources of rural income, new jobs for the urban unemployed and reduced dependence upon external sources for the vital commodities which adversely affect the

balance of payments[35].

It is expected therefore, that when an economy diversifies its export base, no one export commodity should be of so much importance that slight shifts in its price or its conditions in the international market will cause a lot of disruption in that economy's financial situation. For a well diversified economy, there should be very many commodities on its export list, each accounting for a seemingly insignificant share of the total export revenue. It is expected however that the total exports of that economy would be increasing as the economy's export base is diversified.

3.3 THE MALAWIAN EXPERIENCE WITH EXPORT DIVERSIFICATION

Although, Malawi produces and exports several agricultural commodities, the commodity concentration has increased over the past 10 years. The world market prospects for Malawi's three major exports, tobacco, sugar, and tea, which contribute over 80% of the total value of exports, are poor. To maintain any appreciable growth rate of the economy, agricultural exports must be diversified and expanded. The long distances and high transport costs require export crops to be non-perishable and have a high unit value. Malawi has very little under-utilized arable land making it quite important to utilize a production structure that optimizes returns to land. It must be said that generally land and climate resources in Malawi are favorable for a wide range of crops. This is verified by the fact that a large number of

[35]Glantz H. Michael 1987: Drought and hunger in Africa denying famine a future. Pg 382-383. J. Gus Liedenow - Agricultural diversification Cambridge University Press, Great Britain U.K.

crops have been grown on both a commercial and an experimental scale.

However in many cases, economic forces and market demand often resulted in their discontinuation. To date, no attempt has been made to draw agro-ecological zones for specific crops. Therefore, crop diversification has been carried out on an ad hoc basis. The prices of two of the three major export crops are highly volatile, which has created drastic fluctuations in foreign exchange earnings. Tobacco exports dominate the export list. The expansion of tobacco and sugar exports is constrained by informal and formal export quotas for the respective commodities. There are no external constraints to increasing the exports of other commodities, as Malawi's share of world trade is insufficient to materially influence prices.

The high transport costs created by the disruption in the Mozambique route and Malawi being landlocked, limits the type of commodities that Malawi can economically export to those with a high value-to-weight ratio. Traditional exports such as tobacco and confectionery groundnuts meet this requirement, as do the nuts which have recently become export commodities. Though most exportable commodities must be non-perishable, if markets for and reliable supplies of very high value crops were developed, they could be exported by airfreight.

Diversification of agriculture in Malawi has been perceived as an effort not only to enhance the national economy but to improve the economic status of the individual smallholder and estate owner as well. Diversification has been accomplished in a variety of ways. One method has been the introduction of entirely new crops which were found to be

suited to the altitude, climate and other conditions in Malawi. The macadamia tree, for example, which is native to Australia and was hybridized in Hawaii, has proven to be a highly profitable new crop since the confectionery nut has great value in small quantity and is in much demand in Europe and America. Most of the nuts are processed in Malawi itself, thereby extracting maximum value from the product by increasing local employment opportunities and reducing transport costs.

Diversification in Malawi has also been accomplished by returning to crops which had earlier been experimented with or had actually achieved a measure of commercial success at an earlier period. This is the case with rubber, coffee and cotton which were leading estate crops at the turn of the last century until global competition, pests, and administrative mismanagement virtually eliminated them[36]. Recently however, the government has been encouraging expanded production of cassava for both export and domestic use. Perhaps the outstanding example of diversification is sugar which is also relevant to Malawi's approach to import substitution. Prior to 1970, Malawi was a net importer of sugar, with the 36,049 short tons of local production hardly meeting domestic demand. As a consequence of reclaiming swamp and floodplain lands, production by 1981 had reached 145,000 tons ranking Malawi tenth among 29 African producers. It suddenly became a significant exporter of sugar. More importantly, some of the previously exported sugar was converted at Dwangwa into molasses and then into

[36] Macracken, J., (1982), 1982 Experts and Expertise in colonial Malawi. The Malawi Review, 1 (I), 19 - 25.

ethanol[37]. The latter when mixed with gasoline has substantially reduced Malawi's needs for imported petroleum.

It is evident from the resources put into the traditional export crops that Malawi does not find export diversification to mean the broadening of the export base to such a situation where imbalances in the market of any one crop does not significantly affect the export revenue of the country. To the Malawi government export diversification could mean a mere expansionist strategy, in order to obtain more revenue through exports. There is also no clear sign of a serious move to gain access to the international crop market through the local processing of some of the crops in order to improve their competitiveness. A very purposeful export diversification program would go as far as to produce goods that are normally imported. This measure enables the country to import less and therefore use the money, accrued from exports to pay for only the goods or crops that can not be produced locally, as well as for increasing the quantity or quality of the country's export base.

It is important to note that agricultural output in Malawi has grown more from expansion in area and changes in cropping patterns, than from increases in yields per hectare. Yields on estates have risen impressively in Malawi but average crop yields per hectare have not risen significantly on smallholdings. Pressure on land for agriculture is rising fast and the need to increase land and labor productivity is

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[37]Carroll, J. Malawi: Economy in Africa South of the Sahara, 1984-85, 14th edn, pp. 557 - 60 London Europ Publications.

becoming urgent[38].

3.4 THE PERFORMANCE OF EXPORT CROP DIVERSIFICATION PROGRAM

In the bid to analyze the performance of the export diversification program, the data is divided into three subperiods, 1970-78, 1979-83 and 1984 up to present times. Each corresponds to major policy events described in chapter 1 of this report.

The strategy that the Malawian government hoped to use to attain the twin policy objective of food security and export diversification, was to increase maize production through yield-increasing technology (fertilizers and hybrid maize varieties) and to extract some of the land from maize production and to allocate it to the export crop diversification program.

Large part of land left for maize cultivation was to be allocated to the cultivation of the hybrid variety as against opposed to local varieties, and there was to be an expanded use of fertilizers. This meant that the area under hybrid cultivation was to increase, while the land allocated to the local seed varieties was to decline. Malawi hoped that this strategy would lead to production of maize exceeding by far the former peak production, and thus meeting the total food needs of its people.

As more land is shifted away from maize production, the land under export crops would keep increasing. It was expected that in the cultivation of export crops, as well, fertilizers, improved seeds and

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[38] Lele, J. U. Managing agricultural development in Africa. Three articles on lessons from experiences. The World Bank, Washington, D. C. MADIA discussion Paper 2 pg. 6.

pesticides were to be used to ensure increased yield. The number of export crops to be cultivated was to increase to such a point that the area under any one of them would look relatively small, which means a broadening of the export crop base. With yield-increasing technologies, the output of any one export crop was to increase. This was to lead to an improved export capacity which would serve as an indispensable source of export earnings, more stable in nature due to its broad base and less responsive to shocks in the market of any one of its export crops. The country could then be sure of its financial stability with such a built-in external trade shock absorber.

It is the objective of this section of the chapter to see whether Malawi is in the process of achieving its objective of export diversification and if so, to what extent. To achieve this objective, this section of the chapter examines land use patterns during the 1970-88 period. Specifically, the section assesses whether there has been a change in the allocation of land between food and export crops over the period, and within the export crop sector, whether there has been a reallocation of land resource between traditional and new export crops, and between estate and smallholder export crops.

Table 3.1 shows that the share of land area under major export crops --- tobacco, sugar, tea, cotton, groundnut, and coffee -- was about 17.1 percent of the cultivated land area during the 1971-87 period; while food and minor export crops claimed 82.9 percent of the cultivated land area during the period. Looking at different subperiods, the share of land area under major export crops was about 16.4 percent during the 1971-78 subperiod. This share increased at 17.0

percent during the 1979-83 subperiod, and then moved up to 18.8 percent during the 1984-87 subperiod. It is clear from this data that the reallocation of land area between export and food crops has been significantly achieved.

Export crops continued to occupy roughly about 17.0 percent of the cultivated land area while the remaining 83.0 percent of land continued to be allocated to food crops during the period (figure 3.1). Different policy reforms initiated by the Government of Malawi did not stimulate smallholder farmers to divert a substantial portion of their land area to export crops. In fact, there has been a contradiction between the government's export crop diversification program and export crop policy measures.

The allocation of cultivated land area among major and export crops (Table 3.2) further confirms the inconsistencies between export crop diversification program and the government's export crop policy. The share of cultivated land area allocated to tobacco, sugar, tea and coffee -- four traditional estate export crops -- moved from 21.4 percent during the 1970-78 subperiod to 27.2 percent during the 1979-83 subperiod and to 29.3 percent during the 1984-88 subperiod. Among these crops, tobacco saw its area share increase from 15.2 percent during the 1970-78 subperiod to 19.0 percent during the 1979-83 and to 21.0 percent during the 1984-88 subperiod. Sugar had its area share increase from 1.5 percent to 3.4 percent and to 3.2 percent during the three subperiods respectively. Tea crop 9150 experienced the some growth its area share moved from 4.4 percent to 4.4 percent and then to 4.6 percent during the three subperiods respectively. Coffee saw its area share

increasing from 0.2 percent during the 1970-78 subperiod to 0.4 percent during the 1979-83 subperiod and to 0.5 percent during the 1984-88 subperiod.

It is important to underline that sugar, tea, and coffee are estate crops while tobacco is largely grown by estate owners and to a limited extent by smallholder farmers. However, the smallholder's tobacco cultivation has been restricted and discriminated against through a set of pricing and marketing policies (Malawi 1985; Lele et al 1989). Other export crops -- groundnut, and cotton combined -- saw their area share declined from 78.6 percent during the 1970-78 subperiod to 72.8 percent during the 1979-83 subperiod and then to 70.7 percent during the 1984-87 subperiod. These smallholder export crops experienced a significant contraction of their area share during the study period. Groundnut area share declined from 66.0 percent to 64.0 percent and then to 60.0 percent during the three specified subperiods respectively. With respect to cotton its area share declined from 12.6 percent during the 1971-78 subperiod to 8.8 percent during the 1979-83 subperiod and then increased to 10.6 percent during the 1984-87 subperiod. As can be seen, the share of export crop land area allocated to groundnut and cotton combined displays a declining trend during the period as shown in Figure 3.2.

A further comparison of estate and smallholder export crops (Table 3.3) suggests that smallholder export crops were significantly discriminated against relative to estate export crops during the study period. The area under groundnut and cotton, two smallholder crops, declined during the 1971-87 period at an average annual rate of about

1.5 percent and 2.9 percent respectively.

These two smallholder export crops each experienced a 0.4 percent annual rate of decline in their cropped area during the period. The estate export crops -- sugar, tea, coffee, and tobacco (to a large extent) -- enjoyed respectively an average annual rate of growth in their cropped area of about 10.1 percent, 0.3 percent, 12.4 percent, and 3.4 percent during the period. All these estate export crops combined experienced an average annual rate of growth in their cropped area of about 2.9 percent during the study period. In fact, the land area available for smallholder cultivation has been reduced from 1.9 million hectares in 1967 to 1.4 million in 1985. Most of this reduction is the result of transfer of land from the smallholder to the estate section which grew from 67.0 thousand hectares in 1968 to about 691.0 thousand hectares in 1984[39]. Figure 3.3 shows the expansion of cultivated export crops allocated to estate crops vividly in the form of pie charts.

Tobacco, sugar and tea -- predominately estate crops -- still hold a large percentage of the total export capacity and any decline in the international market situation of any one of them will cause significant shocks in the Malawian economy. It is also evident from the total number of export crops that not very many new crops were added to the traditional export crops, and the few export crops added were not given the needed attention to make them contribute meaningfully to the export revenue. The government did not give smallholder farmers the needed incentives for them to expand their export crop base significantly. The

[39]World Bank 1987 "Land Policy Study" Report No. 6757, World Bank, Washington, D.C.

total area cultivated under nontraditional export crops remains negligible. As described earlier, policy measures discriminated against smallholder farmers who ironically controlled, as a group, the bulk of the land; a fraction of which policymakers wanted to divert to export crop production. The export diversification program cannot, therefore, be considered a success.

Table 3.1: Distribution of cultivated land area between food and export crops.

Year	Total cropped area ('000 ha)	Food crops (percent)	Export crops (percent)
1970	2108.0	84.3	15.7
1971	2158.0	82.9	17.1
1972	2218.0	83.3	16.8
1973	2264.0	84.0	16.0
1974	2264.0	83.7	16.3
1975	2264.0	84.6	15.4
1976	2278.0	83.9	16.1
1977	2278.0	83.1	16.9
1978	2298.0	83.0	17.0
1979	2298.0	82.9	17.1
1980	2320.0	83.7	16.3
1981	2320.0	83.4	16.6
1982	2333.0	83.4	16.6
1983	2344.0	81.6	18.4
1984	2345.0	81.4	18.6
1985	2376.0	80.7	19.3
1986	2376.0	81.3	18.7
1987	2377.0	81.5	18.5
1970/78	2236.7	83.6	16.4
1979/83	2323.0	83.0	17.0
1984/87	2368.5	81.2	18.8
1970/87	2289.9	82.9	17.1

Source: FAO, 1990. Food Balance Sheet Tape and Yearbook, various issues. Italy, Rome.

Notes: Each year represents agricultural year; example 1972 = 1972/73. Export crops include three major export crops 9 tobacco, sugar, tea) and three minor crops (cotton, groundnut and coffee).

Table 3.2: Allocation of cultivated land area among major export crops in Malawi.

Year	Major export crop area ('000 ha)	Predominately Estate Crops					Predominately Smallholder Crops		
		Tobacco (percent)	Sugar (percent)	Tea (percent)	Coffee (percent)	All Four (percent)	Groundnut (percent)	Cotton (percent)	All Two (percent)
1970	330.0	12.5	0.8	4.3	0.2	17.8	67.6	14.6	82.2
1971	367.9	13.7	0.7	3.9	0.1	18.4	67.1	14.4	81.6
1972	370.8	15.0	0.8	4.0	0.2	20.0	66.6	13.4	80.0
1973	362.4	13.8	1.2	4.2	0.1	19.4	66.0	14.7	80.6
1974	367.9	14.0	1.5	4.5	0.3	20.3	65.0	14.8	79.7
1975	350.9	14.3	1.9	4.6	0.3	21.0	68.1	10.9	79.0
1976	367.6	16.6	2.4	4.7	0.4	24.0	65.0	11.0	76.0
1977	384.3	17.3	2.4	4.5	0.3	24.5	65.1	10.4	75.5
1978	390.6	19.6	2.3	4.5	0.4	26.8	64.0	9.2	73.2
1979	392.2	20.4	2.3	4.5	0.4	27.6	63.7	8.7	72.4
1980	378.1	16.7	3.7	4.6	0.4	25.4	66.1	8.5	74.6
1981	384.3	17.0	3.9	4.6	0.4	25.8	65.1	9.1	74.2
1982	386.3	17.3	3.7	4.5	0.4	26.0	64.7	9.3	74.0
1983	430.4	23.5	3.4	3.9	0.4	31.2	60.4	8.4	68.8
1984	435.5	20.2	3.2	4.7	0.4	28.6	59.7	11.7	71.4
1985	459.5	22.2	3.0	4.6	0.6	30.4	56.6	13.1	69.6
1986	444.2	21.2	3.2	4.7	0.5	29.5	58.5	11.9	70.5
1987	440.0	21.1	3.2	4.8	0.5	29.5	63.6	6.8	70.5
1988	453.6	20.5	3.4	4.4	0.4	28.7	61.7	9.6	71.3
1970/78	365.8	15.2	1.5	4.4	0.2	21.4	66.0	12.6	78.6
1979/83	394.2	19.0	3.4	4.4	0.4	27.2	64.0	8.8	72.8
1984/88	446.6	21.0	3.2	4.6	0.5	29.3	60.0	10.6	70.7
1970/88	394.6	17.7	2.5	4.4	0.4	25.0	63.9	11.1	75.0

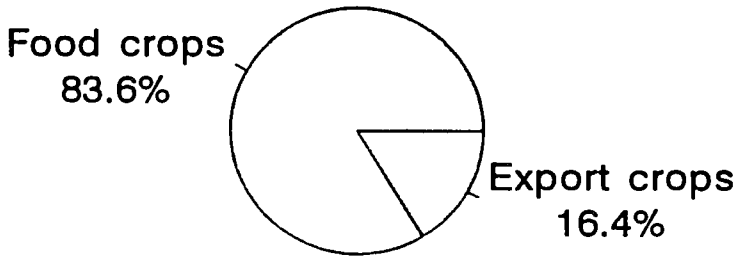
Source: Based on data from: FAO, 1990. Food Balance Sheet Tape Yearbook. Italy, Rome.

Table 3.3: Rate of change of the share of each export crop in total area under export crop cultivation.

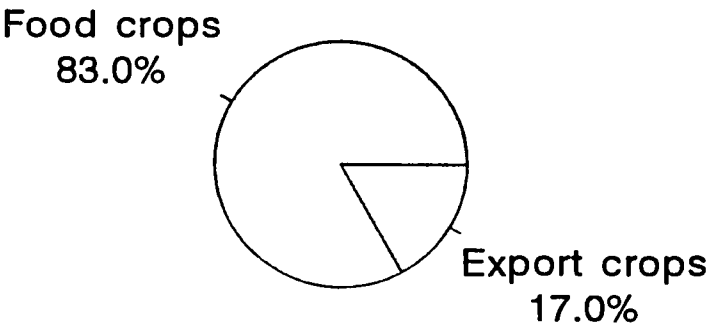
Year	Major export crop area	Predominately Estate Crops					Predominately Smallholder Crops		
	All crops (percent)	Tobacco (percent)	Sugar (percent)	Tea (percent)	Coffee (percent)	All Four (percent)	Groundnut (percent)	Cotton (percent)	Both (percent)
1970									
1971	11.5	9.1	-6.1	-9.0	-48.7	3.4	-0.6	-1.1	-0.7
1972	0.8	9.6	16.1	1.3	87.6	8.7	-0.8	-7.4	-0.2
1973	-2.3	-7.7	51.8	5.1	-45.9	-3.0	-1.0	9.6	0.7
1974	1.5	1.3	17.5	6.9	170.9	4.6	-1.5	0.8	-1.1
1975	-4.6	2.0	31.4	1.7	-15.5	3.4	4.8	-26.5	-0.9
1976	4.8	16.4	23.2	2.6	39.9	14.3	-4.5	0.8	-3.8
1977	4.5	4.2	0.2	-3.8	-4.3	2.1	0.1	-5.0	-0.7
1978	1.6	13.0	-2.7	0.7	6.0	9.4	-1.6	-11.5	-3.0
1979	0.4	4.2	0.6	-1.5	6.7	3.0	-0.4	-5.9	-1.1
1980	-3.6	-18.1	58.0	3.7	3.7	-8.0	3.7	-2.4	3.0
1981	1.6	1.5	6.2	-1.6	4.9	1.6	-1.6	7.6	-0.5
1982	0.5	2.0	-5.6	-0.5	5.7	0.8	-0.5	2.3	-0.3
1983	11.4	35.7	-8.5	-12.8	-5.0	20.0	-6.7	10.3	-7.0
1984	1.2	-13.9	-3.9	19.2	-1.2	-8.3	-1.2	40.0	3.8
1985	5.5	9.5	-6.8	-2.9	47.4	6.3	-5.2	11.5	-2.5
1986	-3.3	-4.4	4.7	3.4	-26.1	-3.0	3.4	-8.6	1.3
1987	-0.9	-0.3	0.9	0.9	0.9	0.0	8.7	-42.9	0.0
1988	3.1	-3.2	5.3	-7.6	-3.0	-2.7	-3.0	41.1	1.1
1970/78	2.2	6.0	16.4	0.7	23.7	5.4	-0.6	-5.0	-1.4
1979/83	2.1	5.1	10.1	-2.5	3.2	3.5	-1.1	-1.7	-1.2
1984/88	1.1	-2.4	0.1	2.6	3.6	-1.5	0.6	8.2	8.2
1970/88	1.9	3.4	10.1	0.3	12.4	2.9	-0.4	-0.4	-0.8

Source: Based on data from: FAO, 1990. Food Balance Sheet Tape Yearbook. Italy, Rome.

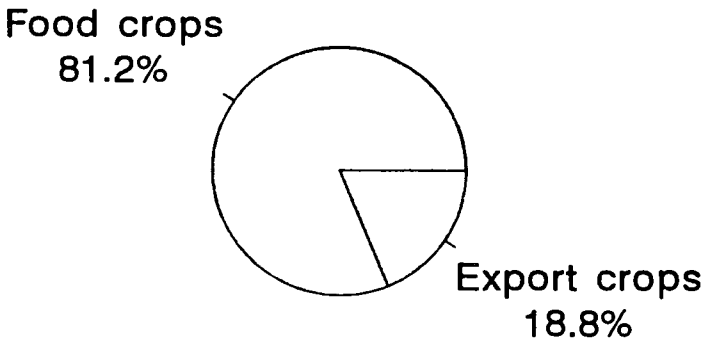
Fig. 3.1: Distribution of cultivated area between food & export crops.



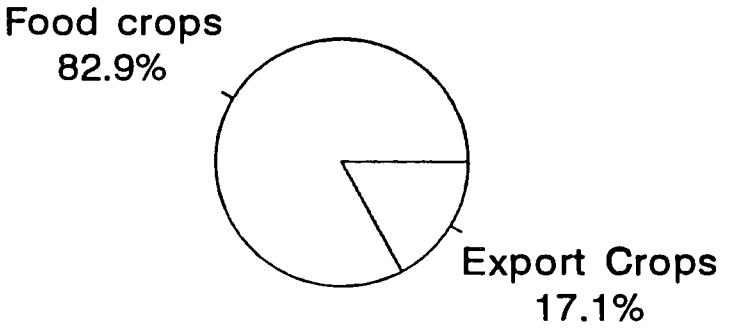
Picture 1: Period 1970-1978.



Picture 2: Period 1979-1983.

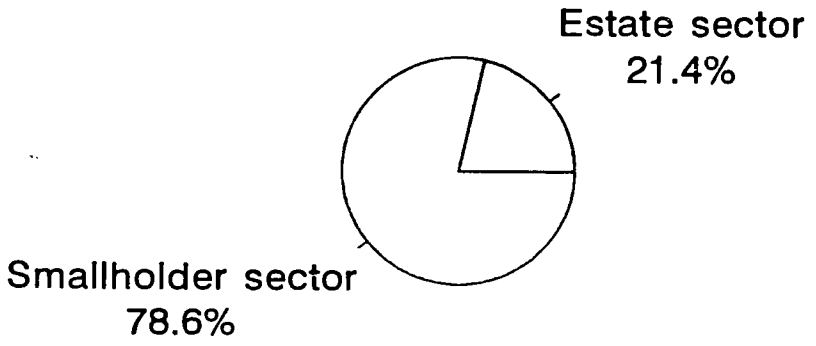


Picture 3 : Period 1984-1987.

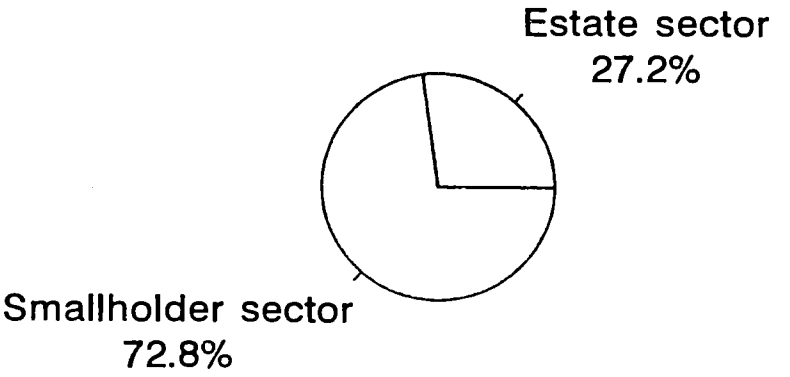


Picture 4: Period 1970-1987.

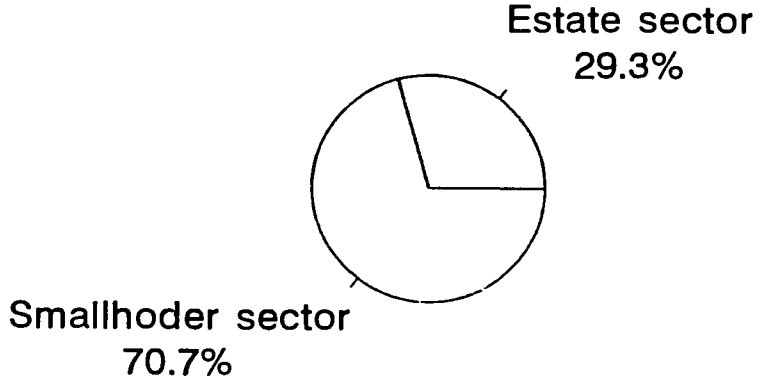
Fig. 3.2:
Allocation of cultivated land area between Estate and Smallholder sectors for major export crops.



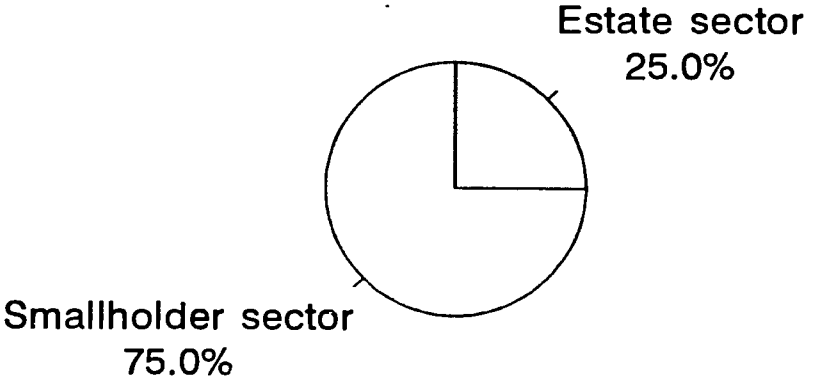
Picture 1: Period 1970-1978.



Picture 2: Period 1979-1983.



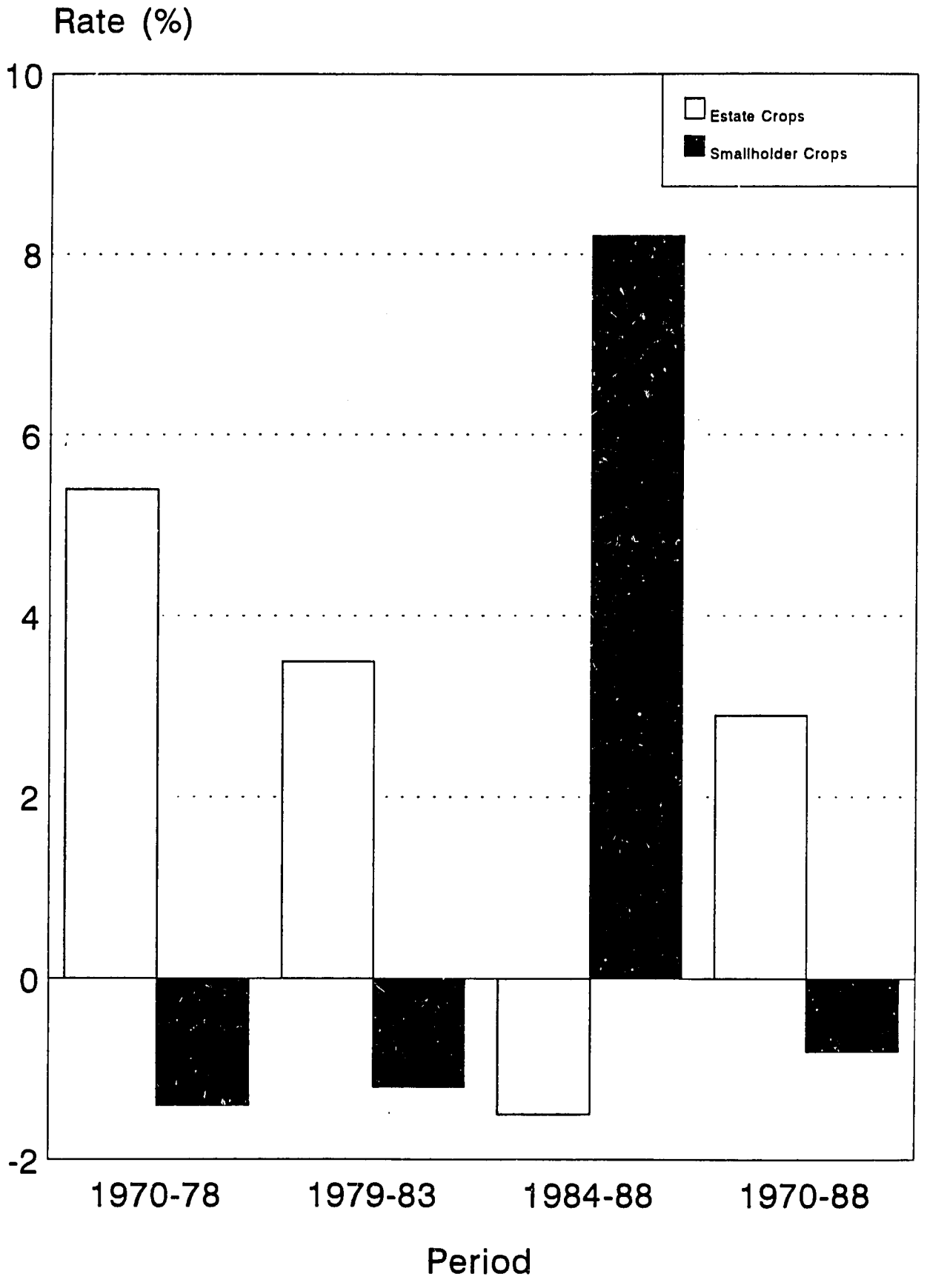
Picture 3: period 1984-1987.



Picture 4: period 1970-1987.

(Estate export crops = tobacco, sugar, tea, coffee) & (Smallholder export crops = groundnut, cotton)

Fig. 3.3: Evolution of rate of change of cultivated area under major export crops in Malawi.



CHAPTER 4

FERTILIZER USE AND IMPROVED MAIZE VARIETIES

Towards the year 2000, 60 percent of the food production in developing countries required to meet the growing demand would have to come from increased yields[40]. About 55 percent of the increase in yields observed in developing countries during the 1965-76 came from fertilizers and there is a clear relationship between widespread use of fertilizers and above-average agricultural production. For all of Africa, FAO estimated that by the year 2000 fertilizer consumption needs will be in the range of 5.7 and 4.1 million tons. The FAO estimates imply a growth rate of 6 percent to 7.4 percent from the mid-seventies to 2000 for all of Africa[41]. The implied growth rate would be much higher for sub-Saharan Africa, which starts from a lower base (FAO, 1986). Mellor, et al[42] have given fertilizers the first functional priority in accelerating food production in sub-Saharan Africa and suggest that even under existing technology it should be feasible to achieve a 15 percent rate of growth in fertilizer consumption. This can

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[40]FAO, 1981. Agriculture: Toward 2000, Rome, Italy.

[41]FAO, 1986. Atlas of African Agriculture, African Agriculture in the next 25 years, Rome, Italy.

[42]Mellor, J. W., C. L., Delgado, and M. J. Blackie (eds) 1987. Baltimore: John Hopkins, University Press.

have a very significant impact on food production.

In view of the fragile nature of sub-Saharan soils and the growing population pressure, Oram et al[43] point out that even to maintain the current low levels of yields with restorative fallow being reduced due to population pressure, special measures will be required to stabilize soil fertility. The relative economics of both raising production through bringing more land under cultivation (as against raising yields) and the imperative of raising labor productivity point to the need for rapidly changing cultivation practices, will involve much greater fertilizer use.

As noted earlier, land reallocation between food and export crops associated with a widespread use of yield-increasing inputs including fertilizers, improved crop seeds, and pesticides were considered by the Government of Malawi to be the basic elements in its efforts to achieve both food self-sufficiency and export crop diversification. This chapter examines the use of fertilizers and the adoption of improved seed varieties, and assesses the relationship between these technologies and the observed crop yields during the study period. This analysis will help to appreciate whether policy reforms have been effective in helping Malawi in its effort to diversify and technologically transform its agriculture.

4.1 FERTILIZER CONSUMPTION AND ALLOCATION

During the 1972-88 period, Table 4.1.a shows that fertilizer use

[43] Oram, P et al (1979. Investment and Input Requirements for Accelerating Food Production in low-income countries by 1990. IFPRI Report 17, Washington, D.C.

expanded fairly consistently, increasing from 27.3 thousand metric tons of nutrients in 1972 to 46.2 thousand metric tons in 1988 (figure 4.1), a compound growth rate of 4.1 percent per year. The average total consumption of fertilizers for the 1972-88 period was 36.4 thousand metric tons of nutrients. Considering the three subperiods during which sectorial and macro-economic policy reforms were initiated, the data indicates that the annual growth rate in fertilizer consumption which was 6.4 percent during the 1972-78 subperiod was reducing at a rate of 1.2 percent during the 1979-83 subperiod before rising again by 6.6 percent during the 1984-88 subperiod. This increase in the growth rate of fertilizer consumption in Malawi is primarily due to increased growth rate of fertilizer consumption in the estate sector. The annual growth rate of fertilizer nutrients in the estate sector increased at a rate of 3.5 percent during the 1972-78 subperiod and fell at a rate of 2.5 percent during the 1979-83 subperiod and then increased to 3.2 percent during the 1984-88 subperiod. The growth rate of smallholder consumption of fertilizer nutrients registered wide fluctuations during the three subperiods. This rate which was 18.7 percent per year during the 1972-78 subperiod reduced to as low as 0.7 percent per year during the 1979-83 subperiod and then rose to 6.5 percent during the 1984-88 subperiod

It should be recalled that policymakers expected (through policy reforms) to lead most farmers to reallocate part of the land under maize to export crops, to shift from local to hybrid maize variety, and to expand the use of fertilizers on hybrid maize and export crops in order to achieve food self-sufficiency and to expand the export crop base.

This implies that fertilizer consumption in both the estate and smallholder subsectors was to expand at an increasing rate during the period.

The fertilizer consumption in the estate sector grew at a much lower rate than expected. The growth rate of fertilizer consumption in the smallholder did not significantly improve during the post-structural adjustment program subperiod as expected. The overall growth rate in fertilizer consumption of 4.1 percent per annum fell short of the recommended annual rate of 15.0 percent for fertilizer use to have a significant impact on agricultural production in a country starting with a small base such as Malawi. It is clear from these data that policy reforms did not have a significant impact on Malawi during the period.

Since a significant share of fertilizers used in Malawi is commercially imported, is this slow growth in fertilizer consumption due to a deteriorating import capacity? To answer this question, a comparison between fertilizer import bill and the agricultural export earnings summarized in Table 4.1.b indicates that 8.9 percent of farm export earnings was spent on fertilizer imports[44]. The slow growth in fertilizer consumption cannot be explained by Malawi's import capacity. The subsequent chapters of the study will examine various factors that have a bearing on fertilizer use at the farm level. Among these varieties, the crop response to fertilizers and the fertilizer and crop prices will receive special attention. In addition, non-price variables will be also examined.

[44]Malawi receives a non-negotiable fertilizer aid. The data related fertilizer aid and commercial fertilizer imports could not be separated in the official statistics related to fertilizer consumption.

4.1.1. Allocation of Fertilizer Between Estate and Smallholder Sector

The analysis of fertilizer use by sector indicates that during the 1972-88 period the smallholder sector received 51.1 percent of total fertilizer nutrients consumed in Malawi and the estate received the remaining 48.9 percent (Table 4.1.a). The share of fertilizer nutrients allocated to smallholder farming during the 1972-78 subperiod was about 42.9 percent. This share moved to 55.6 percent during the 1979-83 subperiod and then to 54.8 percent during the 1984-88 subperiod. The estate sector saw its share of fertilizer nutrients declined from 57.1 percent during the 1972-78 subperiod to 44.4 percent during the 1979-83 subperiod and then increased slightly to 45.2 percent during the 1984-88 subperiod (figure 4.2).

This data appears to suggest that effort was made through policy reforms to allocate more fertilizers to smallholders relative to estate sector during the 1984-85 subperiod. Two things we have to bear in mind are: First, the share of the estate sector in total fertilizer consumption may be underestimated (and that of smallholder sector overestimated) by official statistics due to the leakage of smallholder fertilizers to the estate sector which was estimated at 25.0 percent[45]. The reasons for the leakage are the price differentials between the two sectors and the inadequate fertilizer availability in the estate sector. Second, the estate sector is small relative to the smallholder sector both in terms of cropped land area and of labor force. Taking two major fertilizer-using crops--maize, the most important smallholder crop, and

[45] Conscol A. Fertilizer and Seed Supply and distribution for Smallholder Maize Production in Malawi.

tobacco, the most important estate crop -- the available data indicates that during the 1982-88 period, the smallholder sector controlled 71.0 percent of the cropped land under maize and tobacco while the estate sector claimed only 29.0 percent. Looking at each crop separately, the smallholder sector controlled all the cultivated land under maize crop and 42.1 percent of the cropped area under tobacco. The estate sector had only 57.9 percent of the cultivated land under tobacco and none of the cropped land under maize (Table 4.2).

4.2 TYPES AND QUANTITY OF FERTILIZERS USED IN THE ESTATE AND SMALLHOLDER SECTORS

4.2.1 Types of Fertilizer Used

Table 4.3 indicates that the most fertilizer types used in the smallholder sector are NP (20-20-0), sulphate of ammonium (S/A), calcium nitrogen (CAN), and urea. For the entire period of study these fertilizers recorded an annual average of 5287.6 metric tons for NP, 4141.5 metric tons for S/A, 3697.0 metric tons of CAN and 1006.7 metric tons of urea during the 1972-78 subperiod with S/A contributing 4797.7 metric tons of nutrients, followed by NP with 1730.8 metric tons, CAN with 610.9 metric tons and urea with 152.6 metric tons. The quantity of S/A used by the smallholder farmers however, reduced over the two subsequent subperiods while use of NP, CAN and urea increased.

For the use of fertilizers in the estate sector over the 1972-88 period, tobacco mixtures was mostly used with an annual average nutrient content of 6264.0 metric tons followed by urea with a nutrient content

of 2630.8 metric tons and by S/A with a nutrient content of 1507.5 metric tons and then by CAN with 1377.3 metric tons of nutrient content (Table 4.4).

4.2.2 Consumption of Various Fertilizer Nutrients

The consumption of different fertilizer nutrients in Malawi during the 1972-88 period is displayed in Table 4.5. Nitrogen is the most consumed fertilizer nutrient followed by sulphur, phosphorus and potassium in that order. The consumption of nitrogen during the 1972-88 period was, on average, about 18.9 thousand metric tons per annum, that of sulphur 7.2 thousand metric tons that of phosphorus 6.8 thousand metric tons and that of potassium 3.5 thousand metric tons.

The amount of these nutrients grew at an annual average rate of 6.7 percent for nitrogen, reduced at an annual average rate of 1.1 percent for sulphur while growing at a rate of 8.2 percent for phosphorus and 6.7 percent for potassium during the period. During the 1972-78 subperiod, the annual average rate of growth in the volume of individual nutrients was 6.3 percent for nitrogen, 4.5 percent for sulphur, 8.2 percent for phosphorus and 6.7 percent for potassium. The rate of growth decreased to 4.2 percent for nitrogen during the 1979-83 subperiod but was shrinking at 16.9 percent for sulphur and moved to 7.0 percent for phosphorus while the rate for sulphur reduced to 0.2 percent. As to the 1983-88 subperiod, nitrogen recorded a 9.7 percent growth rate, sulphur 8.1 percent, phosphorus 5.5 percent and then 6.8 percent for potassium. The significant increase in the rate of growth of nitrogen volume from 4.2 percent per annum during the 1972-78 to 9.7

percent per annum during the 1979-83 subperiod seem to indicate the government's commitment to increasing maize output through widespread use of hybrid variety and increased volume of fertilizer nutrients, notably nitrogen.

The analysis of fertilizer nutrient consumption by sector confirms the government's desire to increase maize production. Table 4.6 shows that the smallholder consumption of nitrogen declined from 18.9 percent per year during the 1972-78 subperiod to 7.5 percent per year during the 1979-83 subperiod and then rose to 10.8 percent during the 1984-88 subperiod.

The growth rate of smallholder consumption of phosphorus fell from 40.2 percent per year during the 1972-78 subperiod to 28.5 percent per year during the 1979-83 subperiod and then further declined to 8.9 percent for the 1984-88 subperiod. For the entire period, the consumption of nitrogen and phosphorus in the smallholder sector grew at an average annual rate of 12.8 percent and 26.7 percent respectively. The very high growth rate of phosphorus consumption is partly explained by a rather small base of phosphorus relative to nitrogen. The average annual consumption of nitrogen and phosphorus in the smallholder sector was respectively 11.3 thousand metric tons and 2.8 thousand metric tons during the period under study.

The growth of fertilizer nutrient consumption in the estate sector depicts a similar picture (Table 4.7). The consumption of nitrogen did accelerate during the period, while that of sulphur and potassium fluctuated widely with phosphorus decelerating. The consumption of nitrogen in the estate sector experienced an increasing rate of growth

which moved from 0.4 percent during the 1972-78 subperiod to 0.6 percent during the 1979-83 subperiod and to 8.1 percent during 1984-88 subperiod. The consumption of sulphur, which was increasing at an annual average rate of 11.0 percent during the 1972-78 subperiod, declined at a rate of 3.7 percent during the 1979-88 subperiod and then increased by 10.7 percent for the 1984-88 subperiod. With respect to phosphorus, its rate of growth declined from 7.7 percent per annum during the 1972-78 subperiod to a reduction by 2.5 percent per annum during the 1979-83 subperiod and then to an increase by 2.1 percent during the 1984-88 subperiod. Potassium registered a growth rate of 12.1 percent, 0.2 percent and 6.8 percent respectively for the three subperiods.

In sum, the consumption of nitrogen fell in the smallholder sector and rose in the estate sector during the period, while that of phosphorus fell in both subsectors, with that of sulphur fluctuating in both sectors. It was the Governments' desire to increase the production of maize -- namely hybrid maize, a heavy fertilizer consuming maize variety.

4.3 INTENSITY OF FERTILIZER USE IN MALAWIAN AGRICULTURE

Another variable that assesses the overall performance of the fertilizer subsector is the extent of fertilizer use per hectare of cultivated land area, known also as the intensity of fertilizer use. Table 4.8 shows that the overall intensity of fertilizer use in Malawi was on the average 15.5 kgs of fertilizer nutrients per hectare of cultivated land area each year during the 1972-78 period. During the 1972-78 subperiod, the average amount of fertilizer nutrients used per hectare

of cultivated area was about 13.1 kgs of fertilizer nutrients.

This amount increased to 17.5 kgs of fertilizer nutrients during the 1979-83 subperiod and reduced slightly to 17.0 kgs per hectare for the 1984-88 subperiod. This low level of fertilizer use per hectare of cultivated land implies that a relatively small portion of cultivated area is fertilized and that the rate of use on fertilized portion of the cultivated land area is likely to be sub-optimal. Fig 4.3 shows the intensity of fertilizer use in a graphical form. Furthermore, this amount of fertilizer nutrients used per hectare of cropped area grew at an annual average rate of 2.8 percent during the period. It is important to observe that the rate of growth in the intensity of fertilizer use fluctuated during the period (figure 4.4), falling from 5.8 percent during the 1972-78 subperiod to -1.6 percent during the 1979-83 subperiods before rising to 4.0 percent for the 1984-87 subperiod (Fig 4.4). This data appears to suggest that policy reforms did not help to restore the pre-structural adjustment growth rate level[46].

4.4 DIFFUSION OF THE FERTILIZER/HYBRID MAIZE COMPLEX

Beside fertilizers, another important element of the strategy to achieve both food self-sufficiency and export crop diversification was the hybrid maize variety. This section of the chapter assesses the extent to which policy reforms, initiated in the context of the structural adjustment programs, have helped Malawi's government to promote the use of both fertilizer and hybrid maize in Malawi.

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[46]The lack of detailed data does not allow for a comparison between smallholder and export crops, and among food crops between maize and other food crops.

The section describes the evolution of the maize area under different maize varieties, examines the allocation of fertilized maize area among deficient maize varieties, estimates the rate of fertilizer diffusion on different maize varieties, calculates the share of fertilizer nutrients allocated to different maize varieties, and compares the recommended rate of fertilizer nutrient application with the rate effectively applied on maize by farmers in Malawi.

4.4.1 Allocation and Evolution of Area under different Maize Varieties.

During the 1980-83 subperiod, the area under the maize crop was on average 948.6 thousand hectares per annum (Table 4.9). The local maize variety occupied 90.5 percent of this area; the composite maize variety 3.2 percent, and the hybrid variety 6.3 percent. The annual average area under maize increased to 1162.9 thousand hectares during the 1984-87 subperiod. The share of this area under local maize increased to 92.5 percent, while that under composite and hybrid varieties declined to 1.7 percent and 5.8 percent respectively. Policy reforms appear to have led to unexpected results (Figures 4.5, 4.6, 4.7). They failed to provide the needed incentives to smallholder farmers for them to reallocate land under local maize to hybrid maize.

Furthermore, the area under hybrid maize was declining instead of increasing, as expected (Table 4.10). During the 1980-83 subperiod the area under local and hybrid varieties was increasing at an annual average rate of 18.3 percent and 24.4 percent respectively. The area under composite maize was contracting at an annual average rate of 7.3 percent during the same subperiod. But during the 1984-87 subperiod

when a number of policy reforms were expected to start yielding perceptible effects, the area under local maize continued to grow at a moderate rate of 2.2 percent per annum. The area under the composite variety continued to decline virtually at the same annual rate as during the preceding subperiod. The area under hybrid maize experienced a contraction of about 11.8 percent per annum during the 1984-87 subperiod. The effects observed are contrary to all expectations (Figure 4.8). Once again, policy reforms appear to have been counterproductive in the regard.

4.4.2 Distribution of Fertilized Maize Area and Fertilizer Nutrients Among Different Maize Varieties.

The available data suggests that most maize area fertilized is allocated to local instead of hybrid or composite maize varieties. About 34.6 percent of the fertilized area under maize crop was allocated to hybrid variety during the 1970-71 crop season. This share declined to 29.8 percent in the 1982-83 crop season, and fell further to 28.4 percent during the 1984-85 crop season. The share of fertilized area under maize devoted to local maize moved from 61.1 percent during the 1982-83 crop season to 67.0 percent during the 1984-85 crop season. The composite maize variety saw its share of fertilized maize area declined from 9.1 percent in 1982-83 to 4.7 percent in 1984-85. For the three consecutive crop years (1982-83 - 1984-85), the local maize claimed about 65.7 percent of the fertilized maize area, hybrid variety 28.2 percent and composite variety 6.1 percent (Table 4.11). This again indicates that the farmers placed a high-premium on local maize, their

basic food staple. Policy reforms adopted seem to have failed to alter the composition of different varieties in the maize production structure (Figure 4.9).

With respect to allocation of fertilizer nutrients among various maize varieties, the picture virtually remains the same (Table 4.11). The share of fertilize nutrients devoted to local maize variety declined from 59.7 percent in 1982-83 to 55.9 percent in 1984-85 that of composite maize fell from 6.5 percent in 1982-83 to 5.9 percent in 1984-85. The hybrid maize saw its share of fertilizer nutrients increasing from 33.8 percent in 1982-83 to 38.2 percent in 1984-85. For these three consecutive crop years, 58.4 percent of the fertilizer nutrients allocated to maize production went to local maize, 5.6 percent to composite, and 36.0 percent to hybrid maize. As can be seen, farmers continue to place a high-premium on local maize, their basic food staple. Policy reforms appear not to alter the position of different varieties in the maize production structure.

Some of the reasons advanced for this limited diffusion of hybrid maize include the fact that early hybrid varieties incurred high losses in field and storage, and required the extensive use of insecticides. They also experienced high losses in pounding and are not palatable compared to local varieties. With the release of two new hybrid varieties in the 1990-91 season, it is hoped that farmers will find them superior to local varieties[47].

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[47]Gray, R. W. 1991. Communication from R. W. Gray, National Seed Company of Malawi General Manager, January 1991, Lilongwe.

4.4.3 Rate of Fertilizer Application and Degree of Fertilizer Diffusion on Various Maize Varieties.

During this 1982-85 subperiod, the quantity of fertilizer nutrients used per hectare of cultivated land area was 26.7 kgs of fertilizer nutrients for local maize, 45.6 kgs for composite maize, and 52.0 kgs for hybrid maize (Table 4.12). These rates of fertilizer nutrient application represented 68.5 percent, 49.6 percent, and 39.4 percent of the recommended rate for local, composite and hybrid maize respectively. The question of whether the rate used by farmers represents a sub-optimal use of fertilizer input will be examined in the subsequent chapter of the study where an empirical analysis of fertilizer use on selected smallholder crops will be conducted.

The degree of fertilizer diffusion on the maize crop, measured as the ratio of fertilized maize area over the total maize area, remains small. This indicates that the bulk of maize area is not fertilized and that most maize output is produced without fertilizer input. Scanty information available seems to indicate that during the 1982/85 subperiod only 25.7 percent of the area under maize received fertilizer input. Comparing different maize varieties, 20.5 percent of the area under local maize was fertilized during the subperiod, 54.4 percent of the area under composite received fertilizers, and 86.8 percent of the area sown with the hybrid maize was fertilized (Table 4.13).

Efforts are to be made to expand the area under hybrid maize and to increase the degree of fertilizer diffusion on this varieties. It is hoped that the new hybrid variety will be superior to local varieties in meeting both the consumer's preferences and the farmer's cash need.

Table 4.1a: Fertilizer nutrients consumption in Malawi and its allocation between Smallholder and Estate Sectors.

Year	Total Consumption of nutrients		Smallholder consumption of nutrients		Estate consumption of nutrients		Share of fertilizer nutrients allocated to:	
	Quantity ('000 MT)	Growth Rate (Percent)	Quantity ('000 MT)	Growth Rate (Percent)	Quantity ('000 MT)	Growth Rate (Percent)	Smallholder Sector(%)	Estate Sector(%)
1972	27.3	-	10.1	-	17.2	-	37.0	63.0
1973	27.7	1.5	13.3	31.7	14.4	-16.3	48.0	52.0
1974	25.5	-7.9	6.3	-52.6	19.2	33.3	24.7	75.3
1975	25.3	-0.8	9.3	47.6	16.0	-16.7	36.8	63.2
1976	28.4	12.3	12.7	36.6	15.7	-1.9	44.7	55.3
1977	35.6	25.4	18.7	47.2	16.9	7.6	52.5	47.5
1978	38.4	7.9	19.0	1.6	19.4	14.8	49.5	50.5
1979	38.4	0.0	20.7	8.9	17.7	-8.8	53.9	46.1
1980	45.9	19.5	26.4	27.5	19.5	10.2	57.5	42.5
1981	41.1	*10.5	24.4	-7.6	16.7	14.4	59.4	40.6
1982	43.4	5.6	23.0	-5.7	20.4	22.2	53.0	47.0
1983	34.5	-20.5	18.5	-19.6	16.0	-21.6	53.6	46.4
1984	41.7	20.9	22.5	21.6	19.2	20.0	54.0	46.0
1985	42.1	1.0	21.0	-6.7	21.1	9.9	49.9	50.1
1986	37.6	-10.7	19.9	-5.2	17.7	-16.1	52.9	47.1
1987	39.9	6.1	22.2	11.6	17.7	0.0	55.6	44.4
1988	46.2	15.8	28.1	26.6	18.1	2.3	60.8	39.2
1972/78	29.8	6.4	12.8	18.7	17.0	3.5	42.9	57.1
1979/83	40.7	-1.2	22.6	0.7	18.1	-2.5	55.6	44.4
1984/88	41.5	6.6	22.7	9.6	18.8	3.2	54.8	45.2
1984/88	36.4	4.1	18.6	10.2	17.8	1.5	51.1	48.9

Sources: Based on data from: Malawi, 1986; Ministry of Agriculture; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 1; Fertilizer Consumption in Malawi, as of 1972 to 1985. Lewis B. Williams & H. Allgood; 1990. Fertilizer Situation and Markets in Malawi, IFDC, Muscle Shoals, Alabama, U.S.A., as of 1986 to 1988.

Notes: Each year represents agricultural year; example 1972 = 1972/3
"Total consumption of nutrients" includes Nitrogen, Phosphorus, Potassium and Sulphur from 1972 to 1985 and the first three elements from 1986 to 1988.

Table 4.1b: Share of fertilizer imports in agricultural export earnings.

Year	Fertilizer Imports (Mill. US$)	Agricultural Exports (Mill. US$)	Share (Percent)
1970	2.2	50.4	4.4
1971	3.9	64.2	6.1
1972	3.8	72.2	5.2
1973	3.9	88.5	4.5
1974	6.5	106.8	6.1
1975	17.7	121.5	14.6
1976	10.7	153.4	7.0
1977	12.4	184.2	6.7
1978	16.9	169.3	10.0
1979	14.3	207.4	6.9
1980	19.0	250.9	7.6
1981	29.1	238.4	12.2
1982	26.1	221.4	11.8
1983	26.9	231.7	11.6
1984	33.4	296.7	11.3
1985	28.9	232.3	12.4
1986	23.0	229.5	10.0
1987	29.9	248.9	12.0
1970/78	8.7	112.3	7.2
1979/83	23.1	230.0	10.0
1984/87	28.8	251.9	11.4
1970/87	17.1	176.0	8.9

Sources: Based on data from: Malawi: National Statistics Office, Trade statistics. Various issues; and FAO, 1988: Trade Standard Yearbook.

Table 4.2: Allocation of cultivated area between Smallholder and Estate sectors for the two main fertilizer-using crops.

Year	Maize			Tobacco			Both Crops		
	Area ('000 ha)	Smallholder (Percent)	Estate (Percent)	Area ('000 ha)	Smallholder (Percent)	Estate (Percent)	Area ('000 ha)	Smallholder (Percent)	Estate (Percent)
1982/83	1169.4	100.0	0.0	101.1	27.8	72.2	1270.5	63.9	36.1
1983/84	1182.0	100.0	0.0	88.1	51.2	48.8	1270.1	75.6	24.4
1984/85	1145.0	100.0	0.0	101.9	46.1	53.9	1246.9	73.1	26.9
1985/86	1193.3	100.0	0.0	94.1	39.5	59.5	1287.4	69.8	29.2
1986/87	1182.4	100.0	0.0	93.0	43.1	56.9	1275.4	71.6	29.4
1987/88	1215.0	100.0	0.0	92.8	44.0	56.0	1307.8	72.0	28.0
1982/88	1181.2	100.0	0.0	95.2	42.1	57.9	1276.4	71.0	29.0

Source: Malawi, 1990. Ministry of Agriculture: The Malawi Economic Policy Reform Program, Lilongwe.

Table 4.3: Quantity and main types of fertilizer used in Smallholder sector.

Year	Total Consumption of nutrients		(NP)		(S/A)		(CAN)		(UREA)		(OTHERS)	
	Quantity (MT)	Growth rate (Percent)	Nutrients (MT)	Share (Percent)	Nutrients (MT)	Share (Percent)	Nutrients (MT)	Share (Percent)	Nutrients (MT)	Share (Percent)	Nutrients (MT)	Share (Percent)
1972	10100.0		931.2	9.2	3937.9	39.0	693.7	6.9	38.6	0.4	4500.0	44.6
1973	13300.0	31.7	1706.0	12.8	4833.6	36.3	852.0	6.4	401.6	3.0	5510.0	41.4
1974	6300.0	-52.6	654.4	10.4	2396.5	38.0	173.2	2.7	336.7	5.3	2740.0	43.5
1975	9300.0	47.6	1026.8	11.0	3665.8	39.4	341.1	3.7	96.6	1.0	4170.0	44.8
1976	12700.0	36.6	1659.2	13.1	4958.3	39.0	351.3	2.8	61.2	0.5	5670.0	44.6
1977	18700.0	47.5	2549.6	13.6	7105.4	38.0	827.1	4.4	81.4	0.4	8140.0	43.5
1978	19000.0	1.6	3588.4	18.9	6686.2	35.2	1037.9	5.5	52.0	0.3	7640.0	40.2
1979	20700.0	8.9	3668.0	17.7	7400.2	65.7	1083.2	5.2	92.9	0.4	8460.0	40.9
1980	26400.0	27.5	5387.6	20.4	9162.3	34.7	1234.5	4.7	110.4	0.4	10510.0	39.8
1981	24400.0	-7.6	4247.6	17.4	8926.7	36.6	725.1	3.0	309.6	1.3	10190.0	41.8
1982	23000.0	-5.7	9171.2	39.9	5217.5	22.7	2577.1	11.2	34.0	0.1	6000.0	26.1
1983	18500.0	-19.6	8725.2	47.2	678.7	3.7	8310.6	44.9	n.a	0.0	790.0	4.3
1984	22500.0	21.6	10442.8	46.4	1143.2	5.1	9610.9	42.7	17.0	0.1	1290.0	5.7
1985	21000.0	-8.7	10194.0	46.5	752.9	3.6	9242.2	44.0	n.a	0.0	810.0	3.9
1986	19900.0	-5.2	8769.6	40.3	1407.0	6.5	9081.2	41.7	2500.1	11.5	n.a	n.a
1987	22200.0	11.6	8109.2	33.6	691.3	2.9	7928.5	32.9	7400.9	30.7	n.a	n.a
1988	28100.0	26.6	9057.6	36.4	1442.5	5.8	8780.0	35.8	5580.7	22.4	n.a	n.a
1972/78	12771.4	16.7	1730.8	12.7	4797.7	37.9	610.9	4.6	152.6	1.6	5481.4	43.2
1979/83	22600.0	0.7	6239.9	28.5	6277.1	26.7	2786.1	13.8	109.4	0.5	7190.0	30.6
1984/88	22740.0	9.6	9314.6	41.1	1087.4	4.8	8928.8	39.3	3099.8	12.9	420.0	1.9
1972/88	18594.1	10.2	5287.6	25.7	4141.5	24.8	3697.0	17.5	1006.7	4.6	4495.3	27.4

Sources: Based on data from: Malawi, 1986; Ministry of Agriculture; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 1; Fertilizer Consumption in Malawi, as of 1972 to 1985. Lewis B. Williams & H. Allgood; IFDC, 1990; Fertilizer Situation and Markets in Malawi, as of 1986 to 1988.

Notes: Each year represents agricultural year; example 1972 = 1972/3
"Total consumption of nutrients" includes Nitrogen, Phosphorus and Sulphur from 1972 to 1985 and the first two elements from 1986 to 1988.
n.a refers to not available.
NP = 20% N and 20% P205; S/A = 21% N; CAN = 26% N from 1972 to 1985 and 28% N from 1986 to 1988; UREA = 46% N.

Table 4.4: Quantity and main types of fertilizer used in Estate sector.

Year	Total consumption of nutrients		Tobacco		(S/A)		(CAN)		(CAN)		(OTHERS)	
	Quality (MT)	Growth rate (Percent)	Nutrients (MT)	Share (percent)	Nutrients (MT)	Share (percent)	Nutrients (MT)	Share (percent)	Nutrients (MT)	Share (percent)	Nutrients (MT)	Share (percent)
1972	17224.0		3501.1	20.3	3265.9	19.0	1043.4	6.1	97.1	0.6	9315.5	54.1
1973	14395.0	-16.4	3777.2	26.2	1497.7	10.4	1331.5	9.2	1504.2	10.4	6284.4	43.7
1974	19244.0	33.7	4793.3	24.9	4859.6	25.3	937.6	4.9	118.7	0.6	8534.8	44.4
1975	16036.0	-16.7	5136.1	32.0	2858.5	17.8	1135.7	7.1	151.8	0.9	6753.9	42.1
1976	15686.0	-2.2	5768.8	36.8	1746.2	11.1	1014.0	6.5	78.2	0.5	7078.8	45.1
1977	16904.0	7.8	6284.8	37.2	1692.4	10.0	1488.0	8.8	76.4	0.5	7362.4	43.6
1978	19411.0	14.8	6847.2	35.3	1756.0	9.0	1534.8	7.9	111.8	0.6	9161.2	47.2
1979	17657.0	-9.0	8229.7	46.6	373.4	2.1	2229.0	12.6	1551.1	8.8	5273.8	29.9
1980	19518.0	10.5	6218.3	31.9	1539.7	7.9	1328.1	6.8	3956.9	20.3	6475.0	33.2
1981	18869.0	-14.6	6744.2	40.5	155.4	0.9	1957.5	11.7	3002.0	18.0	4809.9	28.9
1982	20444.0	22.6	7596.2	37.2	1113.4	5.4	470.7	2.3	3550.3	17.4	7713.4	37.7
1983	15977.0	-21.8	6209.2	38.9	298.8	1.9	1433.6	9.0	3800.1	23.8	4235.5	26.5
1984	19189.0	20.1	6419.3	33.5	429.5	2.2	1552.0	8.1	6091.3	31.7	4698.9	24.5
1985	21107.0	10.0	6482.0	30.7	1194.5	5.7	1571.4	7.4	5121.6	24.3	6737.5	31.9
1986	17700.0	-16.1	6498.0	36.7	1197.0	6.8	1586.0	8.9	5106.0	28.8	3331.0	18.8
1987	17700.0	0.0	7182.0	40.6	1050.0	5.9	1596.0	9.0	5520.0	31.2	2352.0	13.3
1988	18100.0	2.3	8799.7	48.6	600.4	3.3	1223.3	6.8	4886.1	27.0	2590.5	14.3
1972/78	16985.7	3.5	5158.5	30.4	2525.2	14.7	1212.1	7.2	305.5	2.0	7784.4	45.7
1979/83	18053.0	-2.5	6999.5	39.0	896.1	3.7	1438.8	8.5	3172.1	17.6	5701.5	31.2
1984/88	18759.2	3.2	7076.2	38.0	894.3	4.8	1502.1	8.0	5345.0	28.6	3941.6	20.6
1972/88	17821.2	1.5	6264.0	35.2	1507.5	8.5	1377.3	7.8	2630.8	14.4	6041.8	34.1

Sources: Based on data from: Malawi, 1986; Ministry of Agriculture; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 1; Fertilizer Consumption in Malawi, as of 1972 to 1985. Lewis B. Williams & H. Allgood; IFDC, 1990; Fertilizer Situation and Markets in Malawi, as of 1986 to 1988.

Notes: Each year represents agricultural year; example 1972 = 1972/3
"Total consumption of nutrients" includes Nitrogen, Phosphorus and Sulphur from 1972 to 1985 and the first two elements from 1986 to 1988.
NP = 20% N and 20% P205; S/A = 21% N; CAN = 26% N from 1972 to 1985 and 28% N from 1986 to 1988; UREA = 46% N.
1986 Tobacco mixtures was of 6% N, 18% P205, 15% K20 and 9% 5 composition vs 5% N, 18% P205, 15% K20 in earlier years.

Table 4.5: Fertilizer Consumption by Nutrients in Malawi.

Year	Total Consumption		Nitrogen		Phosphorus		Potassium		Sulphur	
	Quantity ('000 MT)	Growth rate (percent)	Quantity ('000 MT)	Growth rate (percent)	Quantity ('000 MT)	Growth rate (percent)	Quantity ('000 MT)	Growth rate (percent)	Quantity ('000 MT)	Growth rate (percent)
1972	27.3		12.9		3.5		1.9		1.9	
1973	27.7	1.5	14.1	9.3	3.5	0.0	1.9	0.0	8.1	-11.0
1974	25.5	-7.9	10.9	-22.7	2.9	-17.1	2.2	15.8	9.4	16.0
1975	25.3	-0.8	10.8	-0.9	3.3	13.8	2.4	9.1	8.7	-7.4
1976	28.4	12.3	11.9	10.2	4.3	30.3	3.0	25.0	9.1	4.6
1977	35.6	25.4	16.0	34.5	5.1	18.6	3.1	3.3	11.5	26.4
1978	38.4	7.9	17.2	7.5	6.3	23.5	3.7	19.4	11.3	-1.7
1979	38.4	0.0	16.3	-5.2	6.6	4.8	4.4	18.9	11.0	-2.7
1980	45.9	19.5	21.4	31.3	7.3	10.6	3.4	-22.7	13.8	25.5
1981	41.1	-10.5	18.8	-12.1	6.7	-8.2	3.5	2.9	12.1	-12.3
1982	43.4	5.6	20.9	11.2	9.3	38.8	4.0	14.3	9.1	-24.8
1983	34.5	-20.5	20.0	-4.3	8.3	-10.8	3.5	-12.5	2.7	-70.3
1984	41.7	20.9	25.3	26.5	9.5	14.5	3.4	-2.9	3.4	25.9
1985	42.1	1.0	24.1	-4.7	9.5	0.0	4.7	38.2	3.9	14.7
1986	37.6	10.7	23.9	-0.8	9.4	-1.1	4.3	-8.5	n.a	n.a
1987	39.9	6.1	25.9	8.4	9.3	-1.1	4.7	9.3	n.a	n.a
1988	46.2	15.8	30.9	19.3	10.7	15.1	4.6	-2.1	n.a	n.a
1972/78	29.8	6.4	13.4	6.3	4.1	11.5	2.6	12.1	9.8	4.5
1979/83	40.7	-1.2	19.5	4.2	7.6	7.0	3.8	0.2	9.7	-16.9
1984/88	41.5	6.6	26.0	9.7	9.7	5.5	4.3	6.8	1.5	8.1
1972/88	38.4	4.1	18.9	6.7	6.8	6.2	3.5	6.7	7.2	-1.1

Sources: Based on data from: Malawi, 1986; Ministry of Agriculture; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 1; Fertilizer Consumption in Malawi, as of 1972 to 1985. Lewis B. Williams & H. Allgood; IFDC, 1990; Fertilizer Situation and Markets in Malawi, IFDC, Muscle Shoals, Alabama, U.S.A. as of 1986 to 1988.

Notes: Each year represents agricultural year; example 1972 = 1972/3
"Total consumption of nutrients" includes Nitrogen, Phosphorus and Sulphur from 1972 to 1985 and the first three elements from 1986 to 1988.

Table 4.6: Smallholder Fertilizer Consumption by Nutrients

Year	Total consumption		Nitrogen		Phosphorus		Sulphur	
	Quantity ('000 MT)	Growth rate (percent)	Quantity ('000 MT)	Growth rate (percent)	Quantity ('000 MT)	Growth rate (percent)	Quantity ('000 MT)	Growth rate (percent)
1972	10.1		5.1		0.5		4.5	
1973	13.3	31.7	6.9	35.3	0.9	80.0	5.5	22.2
1974	6.3	-52.6	3.2	-53.6	0.3	-66.7	2.7	-50.9
1975	9.3	47.6	4.6	43.7	0.5	66.7	4.2	55.6
1976	12.7	36.6	6.2	34.8	0.8	60.0	5.7	35.7
1977	18.7	47.2	9.3	50.0	1.3	62.5	8.1	42.1
1978	19.0	1.6	9.6	3.2	1.8	38.5	7.6	-6.2
1979	20.7	8.9	10.4	8.3	1.8	0.0	8.5	11.8
1980	26.4	27.5	13.2	26.9	2.7	50.0	10.5	23.5
1981	24.4	-7.6	12.1	-8.3	2.1	-22.2	10.2	-2.9
1982	23.0	-5.7	12.4	2.5	4.6	119.0	6.0	-41.2
1983	18.5	-19.6	13.4	8.1	4.4	-4.3	0.8	-86.7
1984	22.5	21.6	16.0	19.4	5.2	18.2	1.3	62.5
1985	21.0	-6.7	15.1	-5.6	5.1	-1.9	0.9	-30.8
1986	19.9	-5.2	14.9	-1.3	5.0	-2.0	n.a	n.a
1987	22.2	11.6	17.5	17.4	4.7	-6.0	n.a	n.a
1988	28.1	26.6	21.7	24.0	6.4	36.2	n.a	n.a
1972/78	12.8	18.7	6.4	18.9	0.9	40.2	5.5	16.4
1979/83	22.6	0.7	12.3	7.5	3.1	28.5	7.2	-19.1
1984/88	22.7	9.6	17.0	10.8	5.3	8.9	0.4	6.3
1972/88	18.6	10.2	11.3	12.8	2.8	26.7	4.5	2.2

Sources: Based on data from: Malawi, 1986; Ministry of Agriculture; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 1; Fertilizer Consumption in Malawi, as of 1972 to 1985. Lewis B. Williams & H. Allgood; 1990. Fertilizer Situation and Markets in Malawi, IFDC, Muscle Shoals, Alabama, U.S.A., as of 1986 to 1988.

Notes: Each year represents agricultural year; example 1972 = 1972/73
"Total consumption of nutrients" includes Nitrogen, Phosphorus, Potassium and Sulphur from 1972 to 1985 and the first three elements from 1986 to 1988.

Table 4.7: Estate Fertilizer Consumption by Nutrients

Year	Total Consumption		Nitrogen		Phosphorus		Potassium		Sulphur	
	Quantity ('000 MT)	Growth rate (percent)	Quantity ('000 MT)	Growth rate (percent)	Quantity ('000 MT)	Growth rate (percent)	Quantity ('000 MT)	Growth rate (percent)	Quantity ('000 MT)	Growth rate (percent)
1972	17.2		7.8		3.0		1.9		4.6	
1973	14.4	-16.3	7.2	-7.7	2.6	-13.3	1.9	0.0	2.6	-43.5
1974	19.2	33.3	7.7	6.9	2.6	0.0	2.2	15.8	6.7	157.7
1975	16.0	-16.7	6.2	-19.5	2.8	7.7	2.4	9.1	4.5	-32.8
1976	15.7	-1.9	5.7	-8.1	3.5	25.0	3.0	25.0	3.4	-24.4
1977	16.9	7.6	6.7	17.5	3.8	8.6	3.1	3.3	3.4	0.0
1978	19.4	14.8	7.6	13.4	4.5	18.4	3.7	19.4	3.7	8.8
1979	17.7	-8.8	5.9	-22.4	4.8	6.7	4.4	16.9	2.5	-32.4
1980	19.5	10.2	8.2	39.0	4.6	-4.2	3.4	-22.7	3.3	32.0
1981	16.7	-14.4	6.7	-18.3	4.6	0.0	3.5	2.9	1.9	-42.4
1982	20.4	22.2	8.5	26.9	4.7	2.2	4.0	14.3	3.1	63.2
1983	16.0	-21.6	6.6	-22.4	3.9	-17.0	3.5	-12.5	1.9	-38.7
1984	19.2	20.0	9.3	40.9	4.3	10.3	3.4	-2.9	2.1	10.5
1985	21.1	9.9	9.0	-3.2	4.4	2.3	4.7	38.2	3.0	42.9
1986	17.7	-16.1	9.0	0.0	4.4	0.0	4.3	-8.5	n.a	n.a
1987	17.7	0.0	8.4	-6.7	4.6	4.5	4.7	9.3	n.a	n.a
1988	18.1	2.3	9.2	9.5	4.3	-6.5	4.6	-2.1	n.a	n.a
1972/78	17.0	3.5	7.0	0.4	3.3	7.7	2.6	12.1	4.1	11.0
1979/83	18.1	-2.5	7.2	0.6	4.5	-2.5	3.8	0.2	2.5	-3.7
1984/88	18.8	3.2	9.0	9.1	4.4	2.1	4.3	6.8	1.0	10.7
1972/86	17.8	1.5	7.6	2.9	4.0	2.8	3.5	8.7	2.7	6.3

Sources: Based on data from: Malawi, 1986; Ministry of Agriculture; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 1; Fertilizer Consumption in Malawi, as of 1972 to 1985. Lewis B. Williams & H. Allgood; IFDC, 1990; Fertilizer Situation and Markets in Malawi, IFDC, Muscle Shoals, Alabama, U.S.A. as of 1986 to 1988.

Notes: Each year represents agricultural year; example 1972 = 1972/3
"Total consumption of nutrients" includes Nitrogen, Phosphorus and Sulphur from 1972 to 1985 and the first three elements from 1986 to 1988.

Table 4.8: Intensity of Fertilizer Use.

Year	Total consumption of nutrients ('000 kg)	Cropped area ('000 ha)	Intensity of use (kg/ha)	Growth rate of the intensity of use (percent)
1972	27300.0	2218.0	12.3	
1973	27700.0	2264.0	12.2	-0.8
1974	25500.0	2264.0	11.3	-7.4
1975	25300.0	2278.0	11.1	-1.8
1976	28400.0	2278.0	12.5	12.6
1977	35600.0	2278.0	15.6	24.8
1978	38400.0	2298.0	16.7	7.1
1979	38400.0	2298.0	16.7	0.0
1980	45900.0	2320.0	19.8	18.6
1981	41100.0	2320.0	17.7	-10.6
1982	43400.0	2333.0	18.6	5.1
1983	34500.0	2344.0	14.7	-21.0
1984	41700.0	2345.0	17.8	21.1
1985	42100.0	2376.0	17.1	-0.6
1986	37600.0	2376.0	15.8	-10.7
1987	39900.0	2377.0	16.8	6.3
1972/78	29800.0	2268.3	13.1	5.8
1979/83	40660.0	2323.0	17.5	-1.6
1984/87	40325.0	2368.5	17.0	4.0
1972/88	35800.0	2310.4	15.5	2.8

Sources: Based on data from: Malawi, 1986; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 1; Fertilizer Consumption in Malawi, as of 1972 to 1985. Lewis B. Williams & H. Allgood; 1990. Fertilizer Situation and Markets in Malawi, IFDC, Muscle Shoals, Alabama, U.S.A., as of 1986 to 1988

Notes: Each year represents agricultural year; example 1972 = 1972/3
"Total consumption of nutrients" includes Nitrogen, Phosphorus and Sulphur from 1972 to 1985 and the first three elements from 1986 to 1988.

Table 4.9: Allocation of maize area between different maize varieties.

Year	Total area ('000 ha)	Local Maize Area ('000 ha)	Local Maize Share (percent)	Composite Maize Area ('000 ha)	Composite Maize Share (percent)	Hybrid Maize Area ('000 ha)	Hybrid Maize Share (percent)
1980	768.0	689.0	89.8	34.3	4.5	43.8	5.7
1981	1071.3	954.8	89.1	45.2	4.2	71.3	6.7
1982	826.6	754.7	91.3	18.9	2.3	53.0	6.4
1983	1128.6	1036.7	91.9	19.8	1.8	72.1	6.4
1984	1130.9	1019.7	90.2	23.4	2.1	87.8	7.8
1985	1144.8	1048.4	91.6	21.5	1.9	74.9	6.5
1986	1193.3	1104.6	92.6	20.1	1.7	68.6	5.7
1987	1182.4	1131.5	95.7	13.8	1.2	37.1	3.1
1980/83	948.6	859.0	90.5	29.5	3.2	60.1	6.3
1984/87	1162.9	1076.1	92.5	19.7	1.7	67.1	5.8
1980/87	1055.7	967.5	91.5	24.6	2.4	63.6	6.1

Source: Based on data from: Malawi, 1987; Ministry of Agriculture; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 2; Fertilizer Responses in maize: Yield and Returns as derived from the Annual Survey of Agriculture, Lilongwe.

Note: Local maize variety includes both pure and mixed stand whereas the composite and hybrid varieties are in pure stands.

Table 4.10: Growth rates of area allocated to different maize varieties.

Year	Total maize area		Local maize		Composite maize		Hybrid maize	
	Area ('000 ha)	Growth rate (percent)	Area ('000 ha)	Growth rate (percent)	Area ('000 ha)	Growth rate (percent)	Area ('000 ha)	Growth rate (percent)
1980	768.0		689.9		34.3		43.8	
1981	1071.3	39.5	954.8	38.4	45.2	31.6	71.3	62.9
1982	826.6	-22.8	754.7	-21.0	18.9	-58.3	53.0	-25.7
1983	1128.6	36.5	1036.7	37.4	19.8	4.9	72.1	35.9
1984	1130.9	0.2	1019.7	-1.6	23.4	18.2	87.8	21.9
1985	1144.8	1.2	1048.4	2.8	21.5	-8.1	74.9	-14.7
1986	1193.3	4.2	1104.6	5.4	20.1	-6.4	68.6	-8.5
1987	1182.4	-0.9	1131.5	2.4	13.8	-31.4	37.1	-45.9
1980/83	948.6	17.7	859.0	18.3	29.5	-7.3	60.1	24.4
1984/87	1162.9	1.2	1076.1	2.2	19.7	-7.0	67.1	-11.8
1980/87	1055.7	8.3	967.5	9.1	24.6	-7.1	63.6	3.7

Source: Based on data from: Malawi, 1987; Ministry of Agriculture; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 2; Fertilizer Responses in maize: Yield and Returns as derived from the Annual Survey of Agriculture, Lilongwe.

Note: Local maize variety includes both pure and mixed stand whereas the composite and hybrid varieties are in pure stands.

Table 4.11: Distribution of fertilized maize area and fertilizer nutrients between different maize varieties.

Year	Total fertilized maize area and fertilizer nutrients		Share of fertilized maize area allocated to:			Share of fertilizer nutrients allocated to:		
	Area ('000 ha)	Nutrients metric tons	Local maize (percent)	Composite (percent)	Hybrid (percent)	Local maize (percent)	Composite (percent)	Hybrid (percent)
1982/83	202.0	6198.8	61.1	9.1	29.8	59.7	6.5	33.8
1983/84	273.9	10284.5	69.0	4.6	26.4	59.2	4.9	35.9
1984/85	322.1	10242.5	67.0	4.7	28.4	55.9	5.9	38.2
1982/85	266.0	8869.0	65.7	6.1	28.2	58.4	5.6	36.0

Source: Based on data from: Malawi, 1987; Ministry of Agriculture; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 2; Fertilizer Responses in maize: Yield and Returns as derived from the Annual Survey of Agriculture, Lilongwe.

Table 4.12: Comparison between recommended rates of fertilizer use and the rates used by farmers, 1982/83 - 1984/85.

Maize variety	Variables	Year			
		1982/83	1983/84	1984/85	1982/85
Local	Recommended rate (kgs of nutrients/ha of fertilizer area)	39.0	39.0	39.0	39.0
	Rate effectively used by farmers (kgs of nutrients/ha of fertilizer area)	25.4	30.3	24.4	26.7
	Rate used as a percentage of recommended rate	65.1	77.1	62.6	68.5
Composite	Recommended rate (kgs of nutrients/ha of fertilizer area)	92.0	92.0	92.0	92.0
	Rate effectively used by farmers (kg of nutrients/ha of fertilizer area)	39.8	48.0	49.1	45.6
	Rate used as a percentage of recommended rate	43.3	52.2	53.4	49.6
Hybrid	Recommended rate (kgs of nutrients/ha of fertilizer area)	132.0	132.0	132.0	132.0
	Rate effectively used by farmers (kg of nutrients/ha of fertilizer area)	45.2	58.6	52.2	52.0
	Rate used as a percentage of recommended rate	34.2	44.4	39.5	39.4

Source: Based on data from: Malawi, 1987; Ministry of Agriculture; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 2; Fertilizer Responses in maize: Yield and Returns as derived from the Annual Survey of Agriculture, Lilongwe.

Note: Local maize variety includes both pure and mixed stand whereas the composite and hybrid varieties are in pure stands.

Table 4.13: Rate of fertilizer diffusion on different maize varieties.

Maize variety	Variables	Year			
		1982/83	1983/84	1984/85	1982/85
Local	Total area ('000 ha)	754.7	1036.7	1019.7	937.0
	Fertilized area ('000 ha)	145.2	199.7	235.0	193.3
	Rate of diffusion (percent)	19.2	19.3	23.0	20.5
Composite	Total area ('000 ha)	18.9	19.8	23.4	20.7
	Fertilized area ('000 ha)	10.5	10.8	12.3	11.2
	Rate of diffusion (percent)	55.8	54.6	52.7	54.4
Hybrid	Total area ('000 ha)	53.0	72.1	87.8	71.0
	Fertilized area ('000 ha)	46.3	63.4	74.8	61.5
	Rate of diffusion (percent)	87.2	88.0	85.2	86.8
All maize	Total area ('000 ha)	826.6	1128.6	1130.9	1028.7
	Fertilized area ('000 ha)	202.0	273.9	322.1	266.0
	Rate of diffusion (percent)	24.4	24.3	28.5	25.7

Source: Based on data from: Malawi, 1987; Ministry of Agriculture; Smallholder Fertilizer Revolving Fund; Agriculturalists' Report No. 2; Fertilizer Responses in maize: Yield and Returns as derived from the Annual Survey of Agriculture, Lilongwe.

Note: Local maize variety includes both pure and mixed stand whereas the composite and hybrid varieties are in pure stands.

Fig. 4.1: Fertilizer nutrients consumption in Malawi.

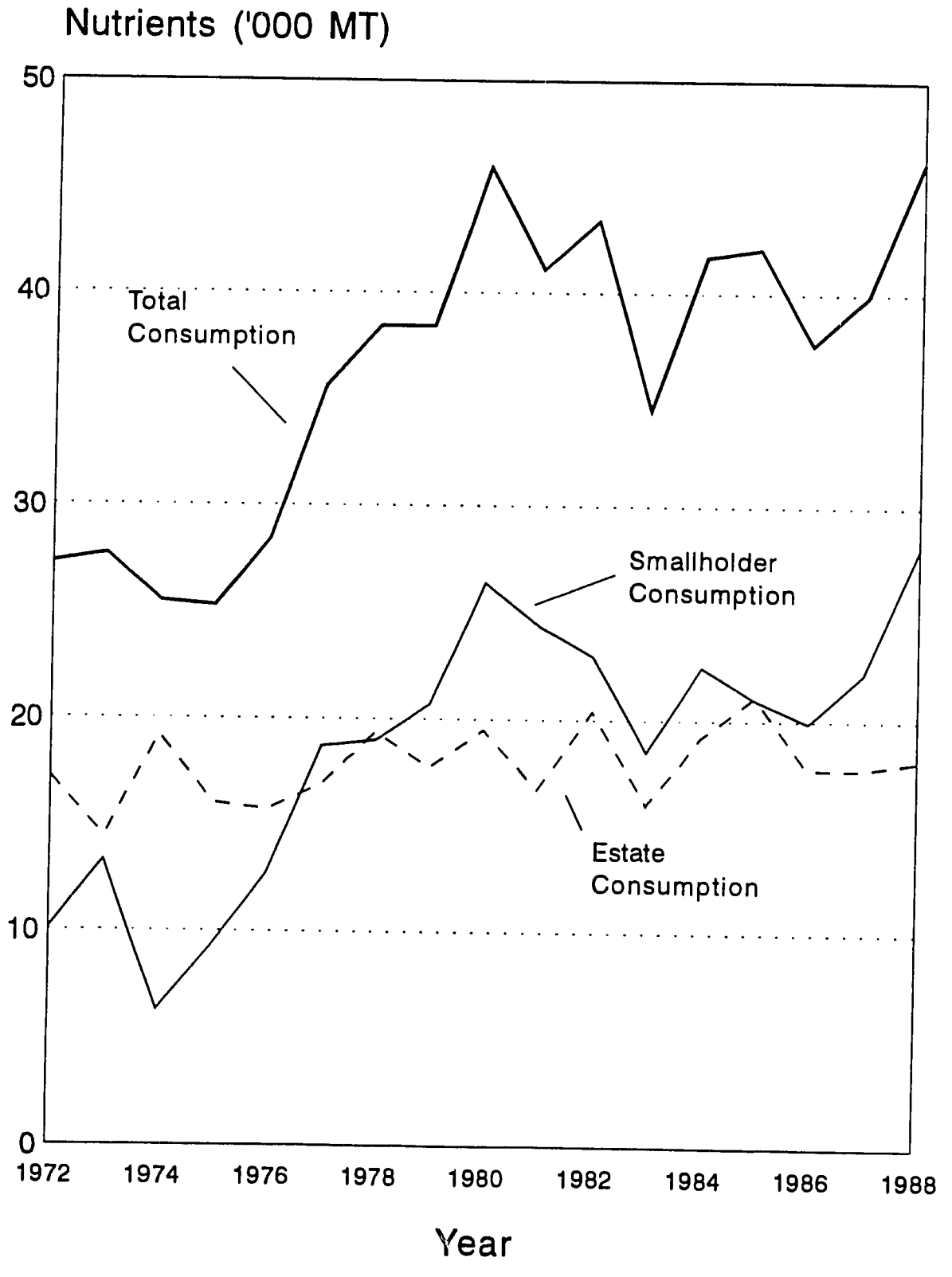
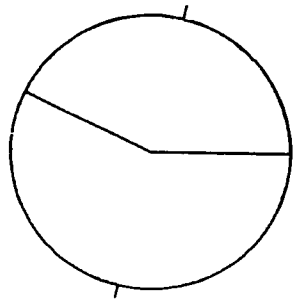
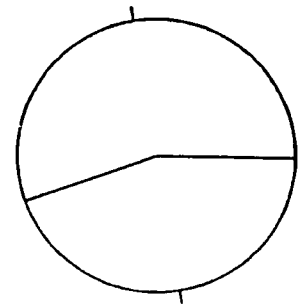


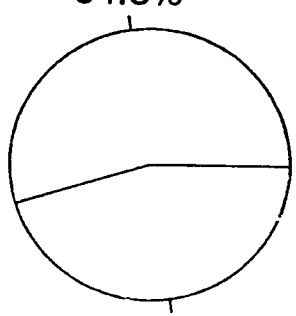
Fig. 4.2: Share of fertilizer nutrients allocated to Smallholder and Estate sectors.



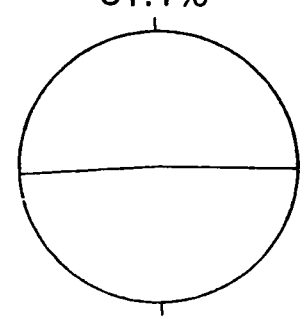
Picture 1: Period 1972-1978.



Picture 2: Period 1979-1983.



Picture 3: Period 1984-1988.



Picture 4: Period 1972-1988.

Fig. 4.3: Intensity of fertilizer use in Malawi.

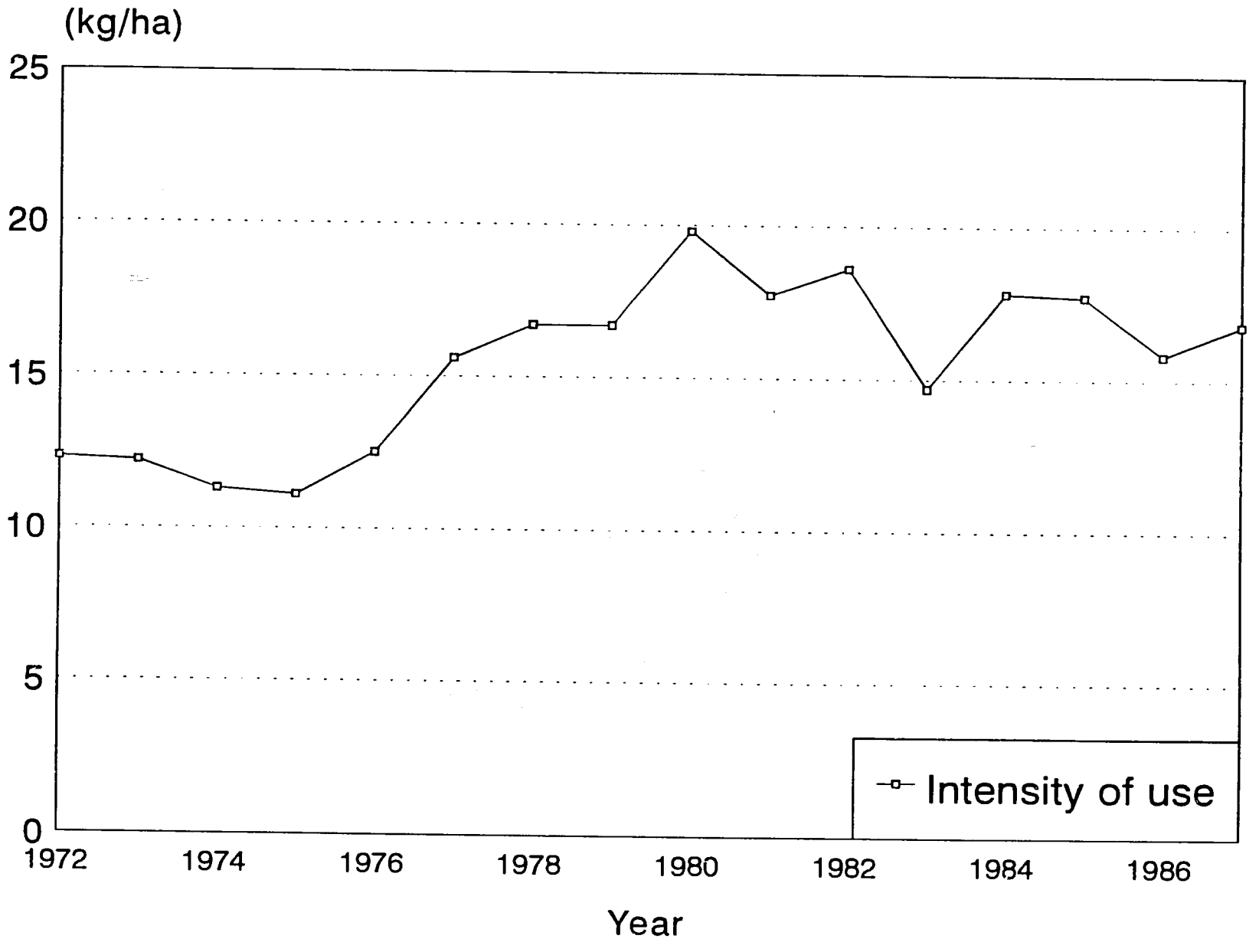


Fig. 4.4: Growth rate of the intensity of fertilizer use.

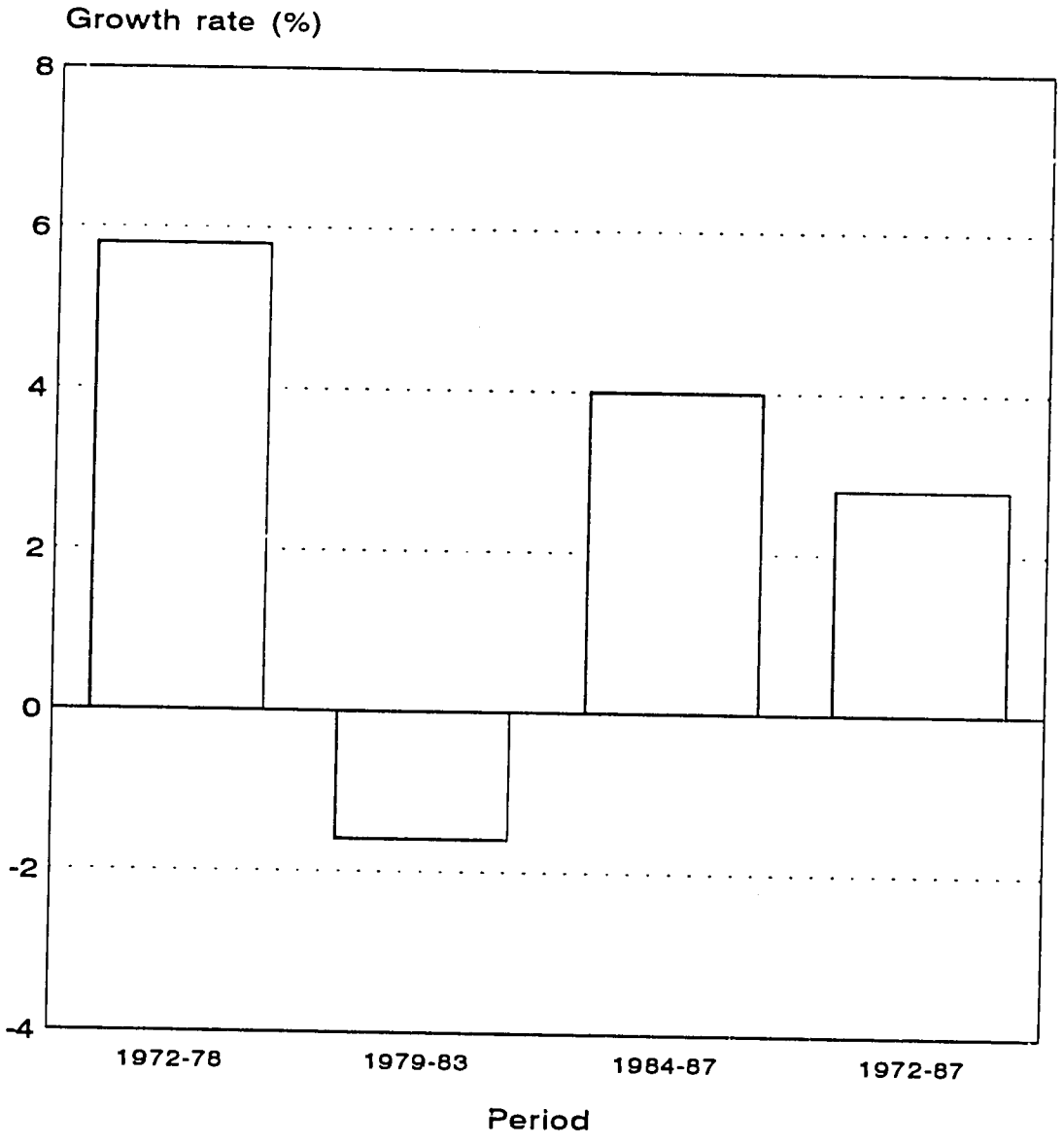


Fig. 4.5: Evolution of area allocated to different maize varieties.

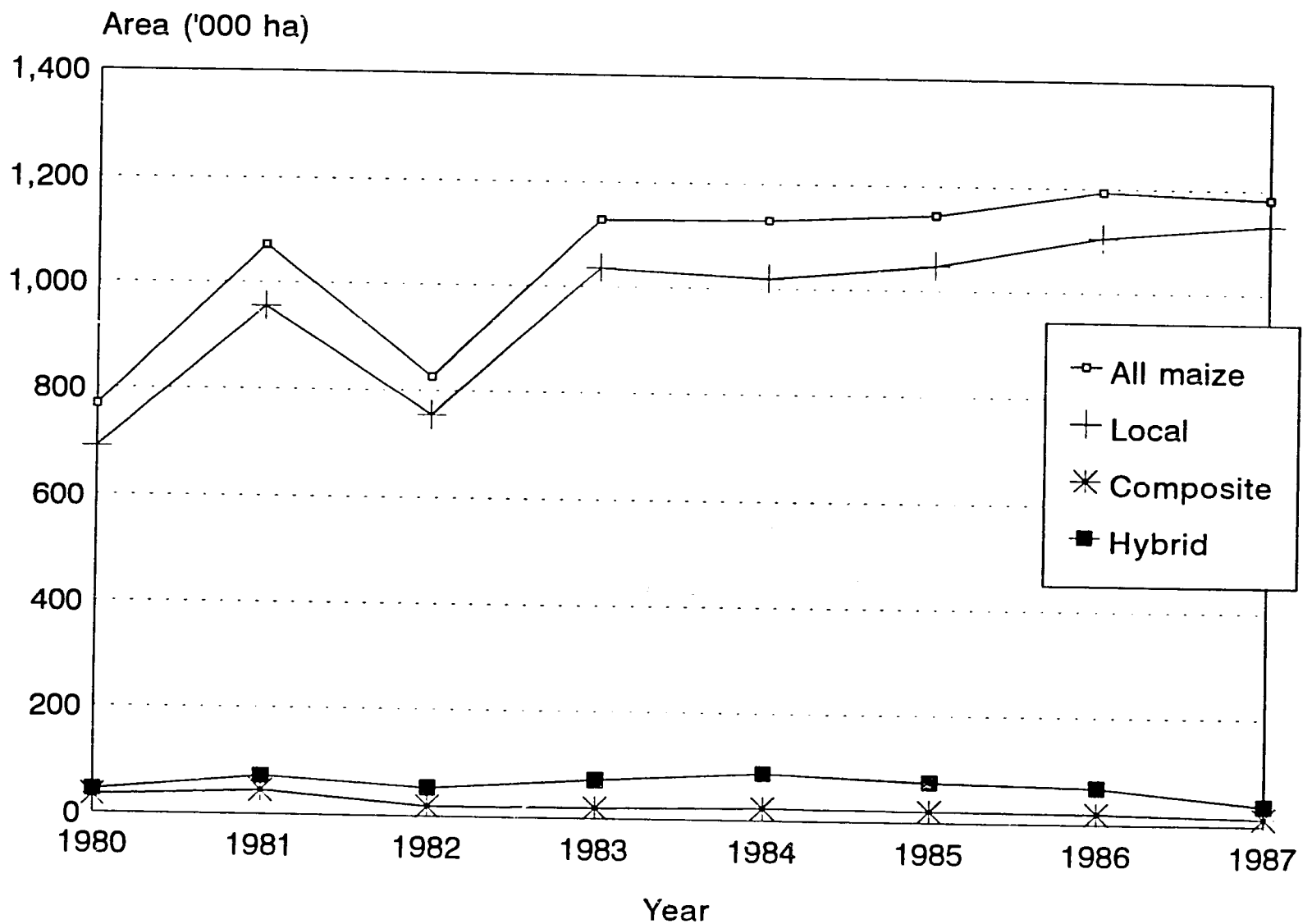
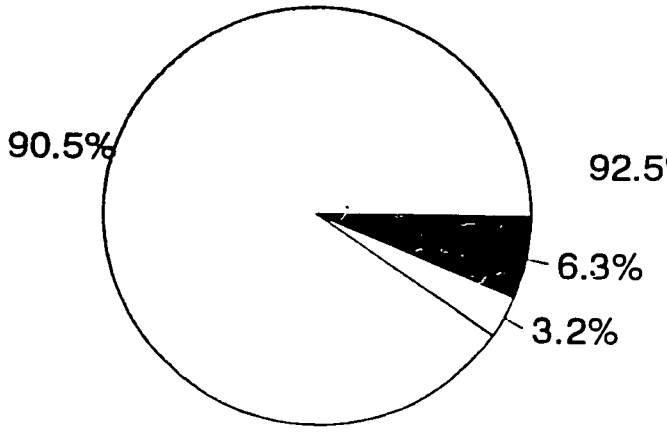
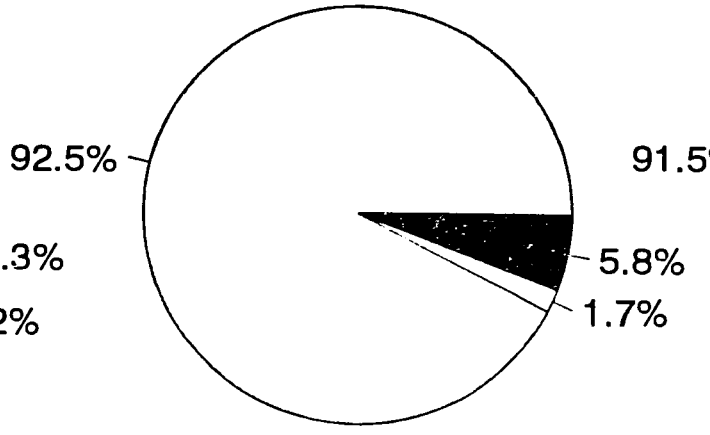


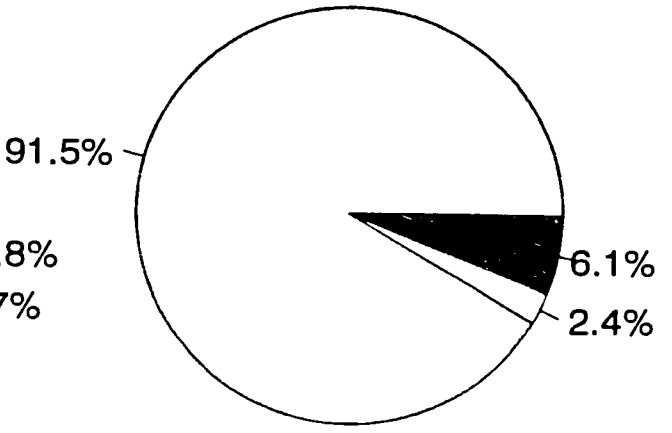
Fig. 4.6: Allocation of maize area between different maize varieties.



Picture 1: Period 1980-1983.



Picture 1: Piriod 1984-1987.



Picture 3: Period 1980-1987.

Local Composite Hybrid

Fig. 4.7: Growth rate of area allocated to different maize varieties.

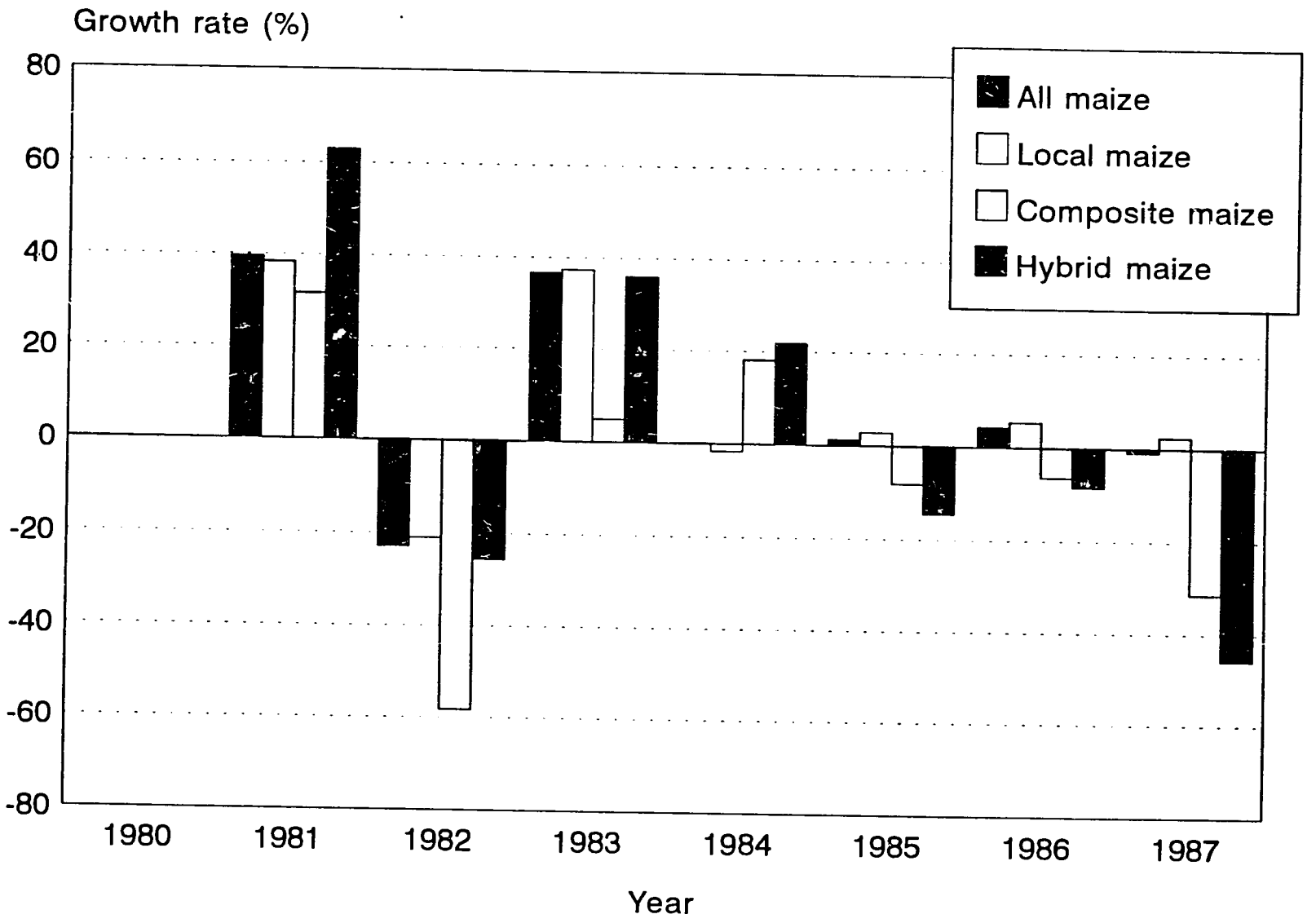
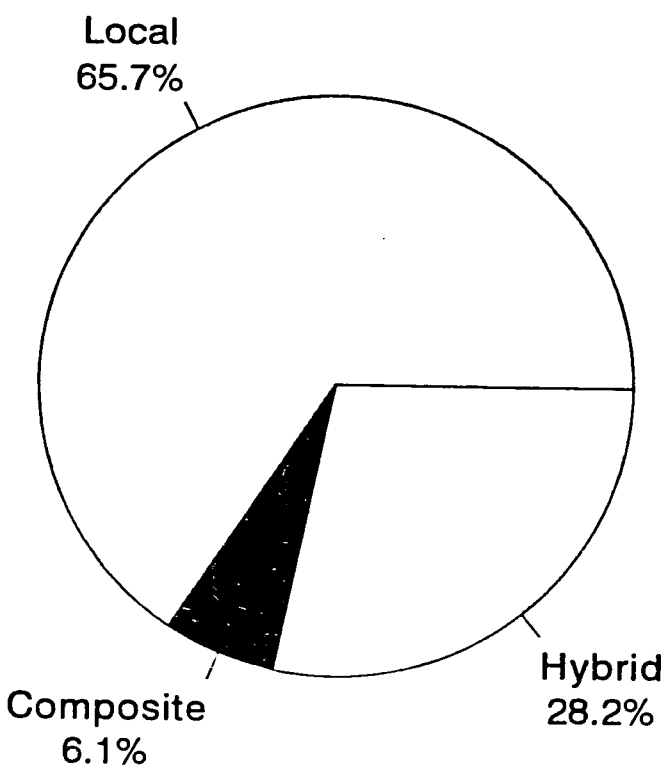
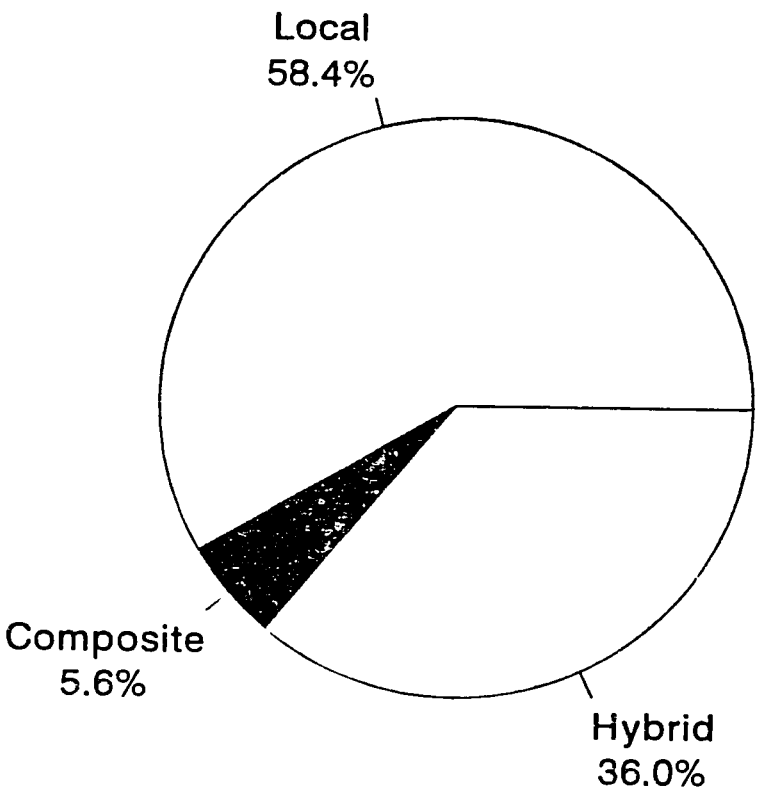


Fig. 4.8:
Distribution of fertilized maize area and fertilizer nutrients between different maize varieties.



Picture 1: Fertilized maize area (1982/1985)



Picture 2: Fertilizer nutrients (1982/1985)

CHAPTER V

ANALYTICAL FRAMEWORK TO EXAMINE THE EFFECTS OF POLICY REFORMS ON THE BENEFITS DERIVED FROM FERTILIZER USE.

The foregoing historical analysis indicates that policy reforms did little to help Malawi improve maize and export crop yields, and change its land use patterns in order to put the country on a path that is consistent with both food self-sufficiency and export crop diversification objectives. The stagnation of crop yields suggests that the use of fertilizers and other improved inputs has remained limited during the study period. This implies that policy reforms did not improve the level of benefits derived from fertilizer use. They failed to eliminate most structural deficiencies in research, extension, crop marketing, fertilizer delivery, and credit system. In this respect, this chapter of the study develops an analytical framework to estimate the returns associated with the use of fertilizers and improved maize varieties, and to examine the effects of policy reforms on the determinants of these returns.

These returns are a function of both the crop response to fertilizer use and the farm-level terms of trade between the fertilizer input and the crop of concern. The study will examine in the subsequent chapters, the effects of policy reforms on these variables and will relate the observed returns to fertilizer use to this effect. The study

will also examine other factors that affect the use of fertilizers in the smallholder sector in Malawi.

5.1 CROP RESPONSE TO FERTILIZER USE

Mathematically, the crop response to fertilizer input is the marginal contribution to crop output associated with the use of one unit of fertilizer input. Formally, the crop response to fertilizer use can be expressed as follows:

$$R_{fi} = \partial Q_i / \partial Q_f \qquad (1)$$

where R_{fi} = crop response to fertilizer use in kgs of crop output per kg of fertilizer nutrients,

Q_i = crop output in kgs,

Q_f = quantity of fertilizer nutrients applied in kgs

In other words, the crop response to fertilizer use is the marginal product of fertilizer input in the production of the crop of concern. Since the marginal product can be linked to the average product, referred to by agronomists as the fertilizer use efficiency, the crop response to fertilizer use can also be expressed as:

$$R_{fi} = e_{fi} \, Af_{fi} \qquad (2)$$

where e_{fi} = elasticity of crop output with respect to fertilizer

input,

A_{fi} = average product of fertilizer input in the production of the crop.

Accepting that the elasticity of crop output with respect to fertilizer input is constant, the parameter to be examined is the average product of fertilizer input. Clearly, the assessment of the evolution of the average product of fertilizer input over the period will then reveal whether an improvement has occurred in this variable as a result of policy reforms to enhance research and extension services. However, the lack of historical data related to crop responses to fertilizer use makes it difficult to conduct this assessment.

5.2 FERTILIZER-CROP TERMS OF TRADE

The fertilizer-crop terms of trade at the farm level is made up of two variables that need to be examined in details in order to assess the effects of economic forces on the level of returns to fertilizer use. These variables are the farm-level crop and fertilizer prices. To begin with, let all the crops be divided into importable, exportable and nontradeable crops. Needless to say that in Malawi fertilizers are imported, and that Malawi is a small country in the world trade. The producer prices for importable and exportable crops can be expressed as follows:

$$P_m = P^w_m \; E \; (1 + t_m) \; (1 - d_m) \qquad (3)$$

$$P_x = P^w_x \; E \; (1 \pm t_x) \; (1 - d_x) \qquad (4)$$

Where P_m = producer price of importable crop in local currency per kg of importable crop output,

P_x = producer price of exportable crop in local currency per kg of exportable crop output,

P^w_m = world market price of importable crop (border price) in foreign currency per kg of the crop output,

P_{wx} = world market price of exportable crop (border price) in foreign currency per kg of the crop output,

E = official exchange rate expressed in units of local currency per unit of foreign currency,

t_m = taxes and levies imposed on importable crop as a percentage of world market price (P_m),

t_x = taxes and levies (subsidies or bonuses) imposed on exportable crop as a percentage of the world market price (P_x),

d_m = cost incurred to transfer the importable crop from the farm to the border. This cost is expressed as a percentage of the price of importable crop after it has been cleared by government [P_m E (1 + t_m)],

d_x = cost incurred to transfer the exportable crop from the farm to the border. This cost is expressed as a percentage of the price of exportable crop after it has been cleared by the government [P_x E (1 $\pm$ t_x)].

Let us note that for nontradeable crops, the farm (or village) is

the appropriate primary market. The price at this market is P_h. As for fertilizer, its price at the farm level can be expressed as follows:

$$P^w_f \quad P_f = P^w_f \, E \, (1 \pm t_f) \, (1 + d_f) \qquad (5)$$

Where P_f = fertilizer price at the farm level in local currency per kg of fertilizer nutrients,

P^w_f = fertilizer world market price expressed as in foreign currency (border price) per kg of fertilizer nutrients,

t_f = taxes and levies (subsidies or bonuses) imposed on fertilizers as a percentage of the world market price (Pf),

d_f = cost incurred to transfer fertilizers from the border to the farm level as a percentage of the price after this product has been cleared by Government [P_f E (1 $\pm$ t_f)].

All the expressions above can be condensed for convenience as follows:

$$P_m = P^w_m \, E \, (G_m) \, (D_m) \qquad (6)$$

$$P_x = P^w_x \, E \, (G_x) \, (D_x) \qquad (7)$$

$$P_f = P^w_f \, E \, (G_f) \, (D_f) \qquad (8)$$

Under this new presentation, G_m, G_x, and G_f are price-distorting policy adjustment factors for importable crop, exportable crop, and fertilizers respectively. While D_m, D_x, and D_f stand for the transfer-cost adjustment factors for the same crops and input respectively. The first factors take account of government price policy distortions. The latter factors reflect both structural and institutional deficiencies associated with the domestic supply, distribution and marketing systems. These deficiencies are translated into high crop and fertilizer transfer costs.

Let us note that G_m, G_x, G_f, D^m, D_x, and D_f are defined in the following nutrients: $0 < G_m < \infty$, $0 < G_x < \infty$, $0 < G_f < \infty$, $0 < D_m < 1$, $0 < D_x < 1$, $0 < D_f < 1$. For any practical purpose, Malawi is a small country in the world market, therefore the world market prices for importables and exportables and fertilizers are given. But through appropriate price and price-related policies, government can affect the producer prices of tradeable crops and the price of fertilizers at the farm level by changing the magnitude of G_m, G_x, G_f, D_m, D_x, and D_f. In so doing, the farm level terms of trade between fertilizers and tradeable crops will also be affected. These terms of trade can be expressed as follows:

$$P_f/P_m = (P^w_f/P^w_m)\ (G_f/G_m)\ (D_f/D_m) \qquad (9)$$

$$P_f/P_x = (P^w_f/P^w_x)\ (G_f/G_x)\ (D_f/D_x) \qquad (10)$$

It is clear that if $G_f/G_m = 1$ or $G_f/G_x = 1$, this suggests that crop and fertilizer price policies do not affect the terms of trade between fertilizer input and these crops. If $G_f/G_m > 1$ or $G_f/G_x > 1$, this indicates that the prevailing crop and fertilizer price policies have turned the fertilizer-crop terms of trade against crop producers. In this case, other things being the same, the use of fertilizers is constrained. But, if $G_f/G_m < 1$ or $G_f/G_x < 1$, this implies that the prevailing price policies related to both tradeable crops and fertilizers have turned the fertilizer-crop terms of trade in favor of crop producers. Here, the use of fertilizers in the production of these crops is promoted.

With respect to the transfer of these tradeable crops from the farm to the market place, if D_m or/and D_x is smaller than 1, this indicates that the transfer system (with all its components) presents serious structural and institutional deficiencies. These deficiencies impede the transfer of the crops from the farm to the markets, and consequently constrain the production of these crops. This is true even if the fertilizer supply and distribution systems face little structural and institutional deficiencies (D_f being close to 1). It will still be difficult for farmers to use more fertilizers in order to produce a high volume of output--which will be difficult to sell at a profitable price level.

Now consider that D_m and D_x are close to 1, that is the transfer system of the tradeable crops is efficient and works smoothly. But consider that fertilizer supply and delivery systems are characterized

by serious structural and institutional deficiencies ($D_f > 1$). Despite the fact that the crop marketing system works efficiently, it will still be difficult for farmers to secure more fertilizers for their crops because the fertilizer supply and distribution systems are inefficient. Here again, the production of the crops will be constrained.

In both cases, the use of fertilizers is constrained, and so is the production of the tradeable crops. The lesson to draw is that, among other things, both the crop and fertilizer distribution and marketing systems have to work efficiently if the use of fertilizers or any other purchased input is to be promoted, and hence crop production. This implies that D_f/D_m and D_f/D_x are close to 1.

For nontradeable crops, it is important to underline that the reference market considered here is the farm or village. These crops are seldom subject to government price distortions. The price of a nontradeable crop at the farm level is: P_h. The farm level terms of trade between the fertilizer input and this crop are given by:

$$P_f/P_h = (E/P_h)\ (P^w_f)\ (G_f)\ (D_f) \qquad (11)$$

From this expression, it is clear that the government of Malawi can affect the farm-level terms of trade between fertilizers and nontradeable crops by changing E, G_f and D_f. A devaluation of the local currency (that is more units of the domestic currency for one unit of foreign exchange) will turn the terms of trade against nontradeable crops. This will discourage the use of fertilizers in the production of

nontradeable crops. A taxation of fertilizers will lead to $G_f > 1$, this will increase the cost of fertilizers in terms of nontradeable crops. This tends to limit the use of fertilizers in the production of these crops. If $G_f < 1$, the terms of trade are distorted in favor of nontradeable crops through government price policies, e.g. fertilizer subsidy. The use of fertilizers, in this case, tends to be stimulated. If $G_f = 1$, that is no price-policy distortion introduced in the fertilizer subsector by the government. In this case, the terms of trade are not affected by government price-policies. Here, the use of fertilizers is neither stimulated nor discouraged.

If fertilizer supply and distribution systems are marked by serious structural and institutional deficiencies ($D_f > 1$), the price of fertilizers in terms of the nontradeable crop will increase, and hence the use of fertilizers in the production of nontradeable crops will decline. The contrary holds for a well functioning fertilizer supply and distribution system.

It is important to note that conceptually nontradeable crops are those crops for which the supply and demand are clear in the domestic market, given the prevailing supply and demand conditions. A widespread use of fertilizers and other innovations will lead to a rightward shift in the supply curve of these nontradeable crops. If the demand schedule does not shift as well, there will be an excess supply in the domestic market. This excess has to be cleared through export; otherwise a decline in the prices of these nontradeable crops will occur, restricting therefore the use of fertilizers on these crops. This is a

long-term scenario that needs to be kept in mind.

In sum, farmers will use fertilizer input or demand more of it, if the following conditions are met: (1) the returns to fertilizer use are statistically significant; (2) farmers have access to well-functioning crop, fertilizer and other input markets, (3) information, fertilizer, and credit/cash are available and accessible to farmers at the appropriate time and location. The first condition assumes that the crop response at the farm level is high and that fertilizer-crop terms of trade are favorable to crop producers. The foregoing methodological note has mostly focused on these two variables. However, it should be added that this study will also examine these other factors stated above.

5.3 FERTILIZER RETURNS

The returns to fertilizer use is given by the ratio of crop response over the cost of fertilizer nutrients expressed in terms of crop output needed to buy one kg of fertilizer nutrients. This expression is known as the fertilizer value/cost ratio. Formally, it is given by:

$$VCR_{fi} = R_{fi}/T_{fi}$$

where VCR_{fi} = fertilizer value/cost ratio,

R_{fi} = crop response to fertilizer use expressed in kgs of output contributed by one kg of fertilizer nutrients,

T_{fi} = farm-level fertilizer-crop terms of trade or fertilizer

cost in terms of crop output, expressed in kgs of crop output needed to purchase one kg of fertilizer nutrients,

This value/cost ratio (VCR) can be interpreted either as the amount of crop output produced as a result of one unit of output of the same crop spent on fertilizer input, or as the crop revenue in local currency generated as a result of one unit of local currency spent on fertilizer input. The evolution of this variable over the study period will be assessed in order to highlight the effects of policy reforms.

It should be recalled that the structural adjustment program (SAP) was predicated, among other things, on enhancing crop responses to fertilizer use through improved agricultural research and extension, increasing crop producer prices, and phasing out and totally eliminating fertilizer subsidies. Therefore, returns to fertilizer use after these policy reforms are expected to be greater than before. In this connection, the evolution of fertilizer returns in maize, rice, and tobacco production will be analyzed and related to policy reforms. This exercise will provide an indication of the direction of resource flow within the smallholder farm sector, thus revealing whether structural adjustment policies were consistent with government's export crop diversification as well as food security objectives.

CHAPTER VI

MAIZE RESPONSE TO FERTILIZER USE

As specified in the methodological note in chapter 4, the crop response to fertilizer use and the farm-level fertilizer-crop terms of trade are the two variables that determine the level of benefits derived from fertilizer use -- fertilizer returns and crop value added. Due to data limitations, this chapter examines only the response of maize to fertilizer use. Specifically, the chapter gives some descriptive statistics on fertilizer use; maize varieties and maize yields in Malawi; and examines the effect of fertilizers and improved varieties on maize yield through an analysis of fertilizer-maize variety response curve. It also compares the effect of the recommended rate of fertilizer use on maize response with that of the rate effectively used by farmers and makes some remarks of policy interest.

6.1 FERTILIZER USE, MAIZE VARIETIES AND MAIZE YIELDS

Despite extensive research done on maize in Malawi, detailed historical data related to fertilizer use on different maize varieties are limited. This makes it difficult to examine the effects of policy reforms on different variables describing the fertilizer seed technology package in maize production. The data used in this chapter are taken from the annual survey of agriculture that was conducted during the

1982/83 - 1984/85 period in Malawi[48].

Table 6.1 shows that the quantity of maize produced without fertilizers was about 849.0 kgs of maize per hectare. This yield increased to 1,291.3 kgs with the use of 26.7 kgs of fertilizer nutrients made up of 21.3 kgs of nitrogen and 5.4 kgs of phosphorus per hectare. This represents an increase in yield of 52.1 percent[49]. The average yield for composite variety without fertilizers was about 1,267.7 kgs of maize per hectare. This yield increased by 43.6 percent when 45.6 kgs of fertilizer nutrients per hectare (34.1 kgs of nitrogen and 11.5 kgs of phosphorus) were used. The hybrid maize yield without fertilizers recorded during the 1982/83-1984/85 period was about 1,018.3 kgs per hectare. This yield increased to 2,527.7 kgs per hectare when 52.0 kgs of fertilizer nutrients per hectare (37.2 kgs of nitrogen, 14.8 kgs of phosphorus) were applied. This represents a 148.2 percent increase.

Table 6.1 also indicates that the degree of variability in local maize yield as shown by the coefficient of variation does not seem to be affected by fertilizer use. This appears to be the same situation for the composite variety, but to a lesser extent. Contrary to the above varieties, the degree of variability in hybrid maize seems to decrease with the use of fertilizers. The production of hybrid maize without fertilizers leads not only to smaller yield, but also to high yield variability.

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[48] Note that this increase in yield cannot be totally ascribed to fertilizer input alone. This estimate does not take into account the effects of variety, weather, labor, and other inputs as well as their interaction on yield.

[49] Malawi, 1987. Ministry of Agriculture. Responses in Maize: Yields and Returns as derived from the annual survey of agriculture Agriculturalists' Report No. 2 Lilongwe.

6.2 MAIZE RESPONSE FUNCTION

The quantity of fertilizer nutrients used per hectare, the maize variety, and the trend are the arguments used to estimate the maize response function. The effects of labor and other inputs not included in the model are taken up in the intercept term. This intercept should not be statistically greater than the average yield of all the varieties combined. Formally, the model can be postulated as follows:

$$Y = f(Q_f, V, T)$$

when Y = maize yield in kgs of maize per hectare,

Q_f = amount of fertilizer nutrients in kgs per hectare

V = maize variety defined as a dummy, taking 1 for the variety of concern, and zero otherwise

T = trend.

A quadratic form in which interaction terms are included is used in this study. The full specification of the model is as follows:

$$Y = a_o + a_1 V_o + a_2 V_1 + a_3 Q_f + a_4 Q_f^2 + a_5 T$$
$$a_6 V_o Q_f + a_7 V_1 Q_f + a_8 Q_f T$$

where Y = maize yield in kgs of maize per hectare

V_o = dummy for local maize variety,

V_1 = dummy for composite maize variety. The dummy V_2 for

hybrid maize is redundant,

Q_f = quantity of fertilizer nutrients in kgs per hectare,

T = trend.

It is expected that the regression coefficients for the local maize variety will be negative and that for other varieties, positive. The regression coefficient for the quantity of fertilizer nutrients used is expected to be positive and the coefficient for its quadratic terms negative. Table 6.2 summarizes the regression results. The fit is very good and the F-value is significantly different from zero at the 1.00 percent level. All the regression coefficients are statistically different from zero at the 1.00, 5.00 and 10.00 percent levels and these coefficients display the expected signs. It is important to observe that the interaction terms between local maize and fertilizer nutrients, and between composite maize and fertilizer nutrients, are negative. This negative sign indicates that these maize varieties are not fertilizer-intensive varieties. This suggests that these maize varieties are not fertilizer-intensive varieties. They can do well with a limited amount of fertilizer input as opposed to hybrid maize, a fertilizer-intensive variety.

Reduced maize response functions are estimated for individual maize varieties. The elasticity of local maize yield with respect to fertilizer nutrients is estimated at 0.2; that of composite maize yield with respect to fertilizer nutrients about 0.2 and that of hybrid maize yield 0.5. The response of maize to fertilizer use is about 11.4 kgs of maize per kg of fertilizer nutrients for local maize, 13.1 kgs for

composite maize, and 33.0 kgs for hybrid maize (Table 6.3).

It is clear that the difference between the response of local maize to fertilizer use and that of composite maize is not statistically significant. This is the first indication why farmers tend to allocate little area and fertilizer input to composite than to local maize that does not need purchased seeds. In fact, the area allocated to the composite variety has been contracting during the period.

6.3 RECOMMENDED AND EFFECTIVELY USED RATES OF FERTILIZER NUTRIENTS

This section attempts to establish whether the rate of fertilizer nutrients used by farmers per hectare of fertilized maize area is the most appropriate. Survey data collected during the 1982/83-1984/85 period, all over Malawi, indicate that the amount of fertilizer nutrients applied to different maize varieties per hectare of fertilized maize area is significantly lower than the recommended quantity. Table 6.4 shows that the rate of fertilizer nutrients applied on local maize was only 68.5 percent of the recommended rate. For composite and hybrid maize varieties, the amount used per hectare of fertilized maize area was 49.6 percent and 39.4 percent of the recommended amount respectively. On the basis of these surveys, some researchers suggest that much effort needs to be deployed to encourage farmers to use the recommended rate of fertilizer nutrients per hectare of fertilizer land area[50]. This conclusion does not appear to be based on a rigorous analysis of the above survey data.

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[50] Lele, U.; R. E. Christiansen; 1989. Fertilizer Policy in Africa: Lessons from development programs and adjustment lending 1970-1987. MADIA discussion Paper 5, World Bank, Washington, D.C.

The technically optimum rate of fertilizer nutrients derived from the response function reported in Table 6.2 is smaller than the recommended rate for all the varieties. For the technically optimum rate of fertilizer nutrients (the rate that allows for the maximum yield), the crop response to fertilizer use which is the marginal product of fertilizer input (first derivative of the response function), is equal to zero. Since the recommended rate is greater than the technically optimum rate, this implies that the response to fertilizer use will be negative with the recommended rate of fertilizer nutrients. For each maize variety, estimated yields are 1,325.1 kgs of local maize per hectare, 707.2 kgs for composite, and 824.5 kgs for hybrid using the recommended rates. The corresponding responses are -2.5 kgs for local maize, -41.1 kgs for composite and -51.6 kgs for hybrid maize.

The analysis reported in Table 6.4 shows that the rates of fertilizer nutrients used by farmers make both technical and economic sense. They correspond to the highest maize response that could be attained, given the crop management and other agricultural practices used by the smallholder farmers in Malawi. The recommended rates for different maize varieties are too high and make little technical and economic sense (Figure 6.1).

At the current level of development of sub-saharan countries, it is difficult to provide site-specific information. Effort needs to be directed at collecting farm-level data in different agro-ecological zones, in order to estimate the appropriate rates of fertilizer use and the corresponding crop responses.

Table 6.1 Descriptive statistics: fertilizer use, maize varieties, and maize yield in Malawi, 1982/83 - 1984/85.

Variable	Mean	Standard Deviation	Coefficient of variation
Yield for local variety without fertilizers in kgs of maize per hectare.	849.0	90.6	10.7
Yield for local variety with fertilizers in kgs of maize per hectare.	1291.3	132.5	10.3
Yield for composite variety without fertilizers in kgs of maize per hectare.	1267.7	97.4	7.7
Yield for composite variety with fertilizers in kgs of maize per hectare.	1820.0	155.8	8.6
Yield for hybrid variety without fertilizers in kgs of maize per hectare.	1018.3	144.8	14.2
Yield for hybrid variety with fertilizers in kgs of maize per hectare.	2527.7	247.8	9.8
Amount of fertilizers nutrients applied on local variety in kgs of nutrients per hectare.	26.7	2.6	9.7
Amount of fertilizers nutrients applied on composite variety in kgs of nutrients per hectare.	45.6	4.2	9.2
Amount of fertilizers nutrients applied on hybrid variety in kgs of nutrients per hectare.	52.0	5.5	10.6

Source: Based on data from Malawi, 1987. Ministry of Agriculture. Fertilizer responses in maize: Yields and Returns as derived from the annual survey of agriculture Agriculturists' Report No. 2, Lilongwe.

Table 6.2 Effects of fertilizer and maize variety, on maize yield in Malawi.

Explanatory Variables and important statistics	Dependent Variable: maize yield (kg/ha)	t-values
Intercept	1162.99	10.86**
V_0	-170.47	-1.92*
V_1	258.89	2.91**
Q_f	35.41	3.24**
Q^2_f	-0.38	-1.72+
T	-73.57	-1.70+
V_0Q_f	-21.59	-3.18**
V_1Q_f	-19.92	-6.57**
TQ_f	6.65	3.99**
R^2	0.97	-
F	62.87	-
n	18.0	-

Source: Based on data from Malawi 1987. Ministry of Agriculture Fertilizer responses in maize: yields and returns as derived from the annual survey of agriculture. Agriculturalists' Report no. 2, Lilongwe.

NOTE: V_0 is the dummy for local variety and V_1 for composite variety. Q_f is the amount of fertilizer nutrients applied per ha of fertilized area, T is the trend taking o for 1982/83, 1 for 1983/84, and 2 for 1984/85.

\+ significant at the 0.10 level.
* significant at the 0.05 level
** significant at the 0.01 level. Table 6.3

Table 6.3 Maize yield elasticities and responses to fertilizer nutrients in Malawi, 1982/83 - 1984/85.

Variable	Value
Elasticity of local maize yield with respect to fertilizer nutrients	0.2
Elasticity of composite maize yield with respect to fertilizer nutrients	0.2
Elasticity of hybrid maize yield with respect to fertilizer nutrients	0.5
Response of local maize to fertilizer nutrients (kgs of maize/kg of fertilizer nutrients)	11.4
Response of composite to fertilizer nutrients (kgs of maize/kg of fertilizer nutrients)	13.1
Response of hybrid to fertilizer nutrients (kgs of maize/kg of fertilizer nutrients)	33.0

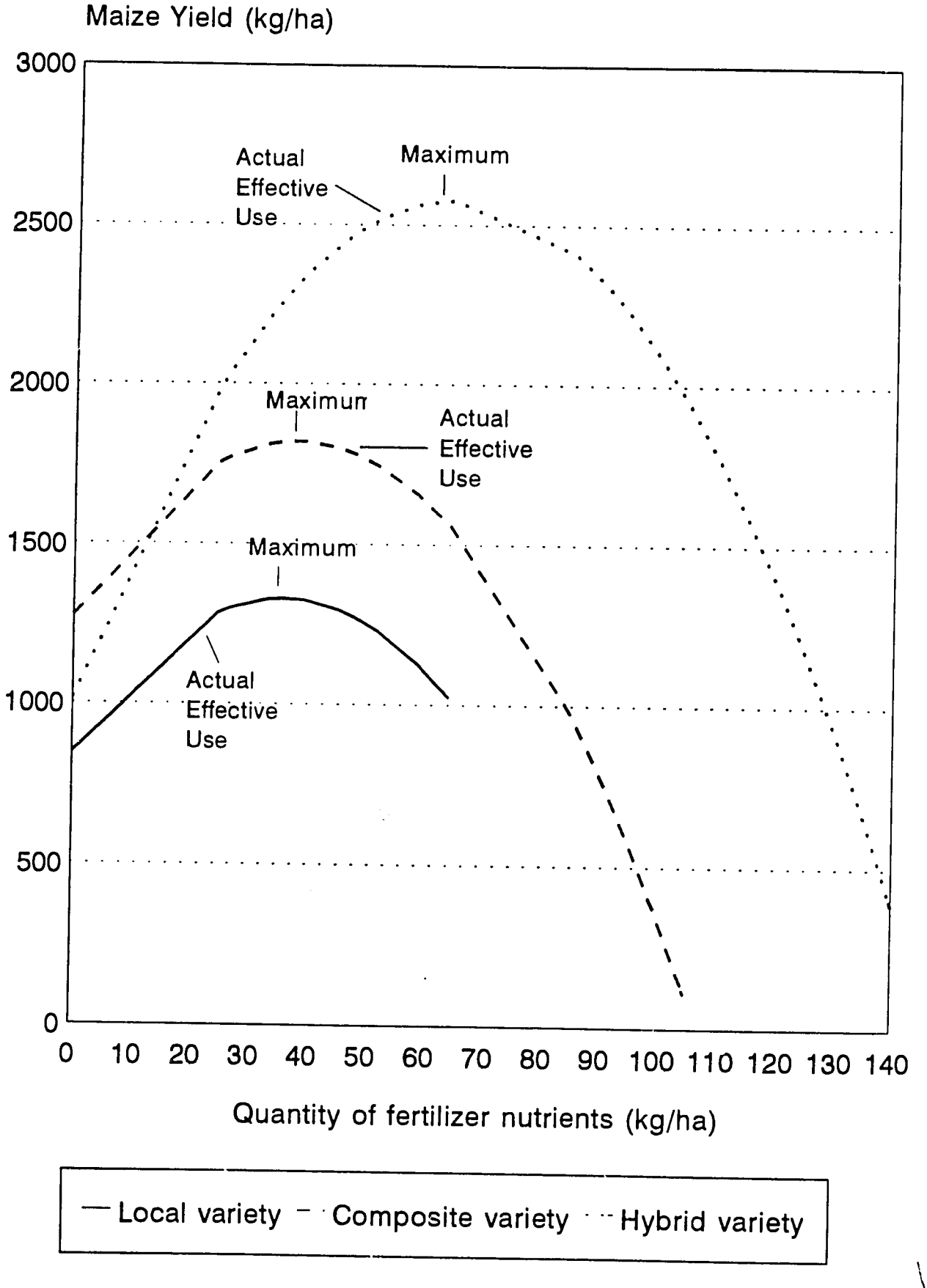
Source: Based on data from Malawi 1987. Ministry of Agriculture. Fertilizer responses in maize: yields and returns as derived from the annual survey of agriculture. Agriculturalists' Report no. 2, Lilongwe.

Note: The elasticity estimates are computed at the mean values of the variables. The response is given as the marginal product of fertilizer nutrients.

Table 6.4: Comparison between recommended, technically optimum, and effectively used rates of fertilizer nutrients per hectare of fertilized area.

Variables examined	Local variety	Composite variety	Hybrid variety
Recommended rate (kgs of fertilizer nutrients per ha of fertilizer area).	39.0	92.0	132.0
Technically optimum rate for the maximum yield.	35.7	37.9	64.1
Rate effectively used during the 1982/83 - 1984/85 period.	26.7	45.6	52.0
Rate used as a percentage of recommended rate.	68.5	49.6	39.4
Observed maize yield without fertilizer used (kg of maize per ha).	849.0	1267.7	1018.3
Estimated maize yield assuming the recommended rate of fertilizer nutrients (kgs of maize per ha).	1325.1	707.2	824.5
Estimated maize yield assuming the technically optimum rate of fertilizer nutrients (kgs of maize per ha).	1329.3	1820.1	2576.8
Observed maize yield for the fertilizer nutrient rate used during the 1982/83 - 1984/85 period (kgs of maize per ha).	1286.0	1812.8	2516.9
Estimated maize response assuming the recommended rate of fertilizer nutrients application.	-2.5	-41.1	-51.6

Fig. 6.1: Maize response curve to fertilizer use.



Annex 6.1: Data used for the regression equation summarized in Table 6.2.

Variable	1982/83	1983/84	1984/85
Yield (kgs of maize/ha) without fertilizers for			
- Local	754	971	822
- Composite	1384	1279	1146
- Hybrid	1223	920	912
Yield (kgs of maize/ha) with fertilizers for			
- Local	1104	1380	1390
- Composite	1721	1699	2040
- Hybrid	2193	2605	2785
Fertilizer nutrients (kgs/ha) applied to			
- Local	25.9	30.3	24.4
- Composite	39.8	48.0	49.1
- Hybrid	45.2	58.6	52.2

Source: Malawi 1987. Ministry of Agriculture. Fertilizer responses in maize: yields and returns as derived from the annual survey of agriculture. Agriculturalists' Report No. 2, Lilongwe.

Note: 21.3 kgs of N per ha and 5.4 kgs of P_2O_5 per ha for local maize, 34.1 kgs of N per ha and 11.5 kgs of P_2O_5 per ha for composite maize, and 37.2 kgs of N per ha and 14.8 kgs of P_2O_5 per hectare for hybrid maize.

CHAPTER VII

FERTILIZER-CROP TERMS OF TRADE AND RETURNS TO FERTILIZER USE

This chapter examines the farm-level fertilizer-crop terms of trade and assesses the level of fertilizer returns in the smallholder farm sector of Malawi. Two variables define the fertilizer-crop terms of trade. They are the fertilizer and crop prices. Fertilizer policy has been a subject of serious debate among policymakers, donors, and economists alike. This debate has focused on the issue of fertilizer subsidy. This study does not attempt to provide a detail analysis of this issue that has been at the center of many studies on pricing policy. Some of these studies see some merit in fertilizer subsidy, while others consider this pricing policy as an inefficient way of promoting the use of fertilizer and other improved inputs. The latter view seems to prevail among donors and international financial institutions.

The phasing out and the total elimination of fertilizer subsidy have been adopted as part of policy reforms under structural adjustment programs. The structural adjustment program also includes measures to develop a competitive market system that will promote increased efficiency and decreased cost in the distribution and the marketing of farm products and inputs. Bangladesh was able to synchronize the fertilizer subsidy removal programs with the development of such a

competitive market system. This effort led to decreased fertilizer price and increased fertilizer use (Bumb 1991).[51]

As a part of common knowledge, it is well established that the development of a competitive market system for both inputs and products is one of the key conditions to getting any economic activity moving. Providing subsidies as a way of alleviating the effects of market distortions cannot be considered as an efficient and sustainable solution particularly for developing economies. The case of Senegal is a good example. Despite a long history of fertilizer use, the removal of fertilizer subsidy resulted in a staggering drop in fertilizer use (Bumb 1991). The long-term solution to promoting the use of fertilizer and other inputs resides in improving the product and input markets, other services, infrastructures and institutions. A serious alternative policymakers need to consider is whether subsidy funds could be used to develop these economic structures and/or to provide credit to more farmers. This study will examine the extent to which fertilizer subsidy has reduced the cost of this input at the farm level and ultimately the fertilizer-crop terms of trade.

With respect to crop prices, the debate has been on whether both importable and exportable crops need to face the world market prices. Studies have shown that importable crop producers have been subsidized through trade and exchange rate policies, while the exportable crop producers have been taxed. These policies have had very pervasive

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[51] Bumb, B., 1991. The policy environment and fertilizer sector development: an overview. Manuscript. Training workshops on Policy Issues Affecting Fertilizer Sector Development and Sustainable Agriculture, September 9-20, 1991. International Fertilizer Development Center (IFDC), Muscle Shoals, Alabama, USA.

effects on the agricultural sector in the Sub-Saharan Africa (Oyejide 1986, Tshibaka 1986, and Elbadawi 1992).[52] This study does not attempt to go into details related to the effects of trade and exchange rate policies on agricultural prices. The study will, however, examine the extent to which importable and exportable crop prices have been affected relative to world market prices by trade and other domestic price and marketing policies. This chapter will also examine other factors affecting the prices of both fertilizers and crops, therefore the fertilizer-crop terms of trade and, finally, the implications for the returns to fertilizer use in the smallholder farm sector in Malawi.

7.1 EVOLUTION OF FARM-LEVEL FERTILIZER-TERMS OF TRADE

Table 7.1 presents the farm-level terms of trade between fertilizer input and maize, and between fertilizer input and rice. During the 1972-78 subperiod, the farm-level fertilizer-maize terms of trade were 5.7 with subsidy and 7.5 without subsidy, representing a 24.0 percent reduction in the farm-level fertilizer price expressed in kgs of maize per kg of nutrients. With respect to rice, the farm-level fertilizer-rice terms of trade were 2.8 with subsidy and 2.7 without subsidy, indicating that the fertilizer subsidy led to a 24.3 percent reduction

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[52]a.Oyejide, T.A. 1986. The effects of trade and exchange rate policies on agriculture in Nigeria. Research Report 55. Washington, D.C.: International Food Policy Research Institute.

52b.Tshibaka, Tshikala, B. 1986. The effects of trade and exchange rate policies on agriculture in Zaire. Research Report 56. Washington, D.C.: International Food Policy Research Institute.

52.c.Elbadawi, I. 1992. Real Overvaluation, Terms of Trade Shocks and the Cost to Agriculture in Sub-Saharan Africa: the Case of the Sudan. Journal of African Economies, Vol. 1, No. 1, Oxford University Press.

in the farm-level price of fertilizers expressed in kgs of rice per kg of nutrients.

During the 1979/83 subperiod, this variable displayed value at 6.0 with subsidy and 7.9 without subsidy in the production of maize. This gives a 24.1 percent reduction in the farm-level price of fertilizers expressed in kgs of maize per kg of nutrients. With respect to rice, the fertilizer-rice terms of trade were 4.7 with subsidy and 6.3 without subsidy, representing a 25.4 percent reduction in the farm-level price of fertilizer expressed in terms of kgs of rice per kg of fertilizer nutrients.

During the last (1984-88) subperiod, the farm-level fertilizer-maize terms of trade were 8.8 with subsidy and 11.2 without subsidy, representing a 21.4 percent reduction in the farm-level fertilizer price expressed in kgs of maize per kg of nutrients. With regard to rice, the fertilizer-rice terms of trade were 5.8 with subsidy and 7.5 without subsidy, indicating a 22.7 percent reduction in the farm-level price of fertilizer expressed in kgs of rice per kg of nutrients.

For the entire (1972-88) period, the farm-level fertilizer-maize terms of trade were 6.7 with subsidy and 8.7 without subsidy. This gives a 23.0 percent reduction in the farm-level price of fertilizers expressed in kgs of maize per kg of nutrients. As for rice, the terms of trade between fertilizers and this crop were 4.3 with subsidy and 5.6 without subsidy, representing a 23.2 percent reduction in the farm-level price of fertilizers expressed in kgs of rice per kg of nutrients.

Even the keeping of fertilizer subsidy did not improve the situation. The farm-level price of fertilizers relative to maize and

rice continued to increase during the entire period (Figures 7.1 and 7.2). It could be said that the picture was the same for the entire food sector in Malawi. Figure 7.3 indicates that the trend has also been the same for tobacco in both the smallholder and estate sectors. Table 7.2 shows that the terms of trade between subsidized fertilizers and smallholder tobacco moved from 1.1 during the 1979/83 subperiod to 1.3 during the 1984/87 subperiod. When subsidy is disregarded, the terms of trade between fertilizer and smallholder tobacco moved from 1.4 to 1.6 during the above subperiods. For estate sector, the terms of trade between fertilizer and tobacco moved from 0.5 during the 1979/83 subperiod to 0.9 during the 1984/87 subperiod. Policy reforms did improve the price of farm products relative to fertilizer input. This conclusion could be extended to other technology-caring inputs including improved seeds and pesticides.

7.2 FERTILIZER PRICE

The increasing trend observed in the farm-level fertilizer-crop terms of trade implies that the farm-level price of fertilizers increases much faster than the crop producer price. Increases in fertilizer prices at the farm level can be attributed to changes in import and domestic marketing costs, and to the types of fertilizers being used. Taking 1987/88 as base year, Table 7.3 clearly shows that the domestic marketing costs, the import price at Durban port in South Africa, and the external transport costs related to NP (20-20-0) have significantly increased during the 1987/90 subperiod. Interest on working capital followed by indirect (other) marketing costs (tender

commission and insurance) and the direct marketing costs (domestic transport, rebagging, storage, selling losses and fees) have increased at a rather abnormal rate. This suggests serious structural and institutional deficiencies. This corroborates the fact that government's intervention in marketing is often harmful. The increases in different import cost elements, although substantial, remain relatively much lower than the increases in the domestic marketing cost elements. This analysis can be extended to other fertilizer types. The picture remains the same. This exercise supports the view that input as well as output markets must be privatized and that the government should play only a facilitative role.

Another action that could be taken in the short-run in order to reduce the cost of fertilizer use is to select among many fertilizer types currently used in Malawi those that are ecologically sound and cost-effective. Table 7.4 shows that during the 1972/88 period, NPK nutrients used in the smallholder sector came from both compound and single fertilizers. These fertilizers include primarily NP (20-20-0), sulphate of ammonium (S/A) with 21 percent of N, and calcium nitrate (CAN) with 26 percent of N from 1972 to 1986 and 28 percent of N thereafter. Table 7.4 reveals that NP (20-20-0) was the least expensive type of fertilizer. Taking this fertilizer type as a "reference", Table 7.4 shows that S/A was about 52.3 percent more expensive and CAN was about 40.0 percent more expensive than NP (20-20-0). This has been the trend during the entire period under study. As can be seen, a proper selection of fertilizer types will greatly reduce the price of

fertilizer nutrients at the farm level. This will lower the price of fertilizer relative to crop.

In addition to the above factors, the exchange rate could also affect the terms of trade between fertilizer input and crops. Since uniform exchange rate policy was applied to both imports and exports, it is clear as shown in the methodological note, that exchange rate fluctuations did not affect the terms of trade between tradable commodities; e.g. fertilizer and maize, fertilizer and rice or, fertilizer and tobacco. These fluctuations in nominal exchange rate do not significantly affect the terms of trade between tradables and nontradables that are substitutes. For nontradables that are not close substitutes, the change in exchange rate affects the terms of trade between fertilizers and these commodities. Since all the food crops in Malawi are substitutes, a change in the price of a tradable food crop (maize or rice) resulting from exchange rate fluctuations will lead to a change in the price of a nontradable food crop (sorghum) such that the terms of trade between fertilizer and the nontradable crop remain unaffected.

However, a change in the exchange rate will affect the use of fertilizers during the crop season if farmers use cash to purchase this input or if the amount of credit allocated to the same input does not expand accordingly. In fact, Figure 7.4 indicates that the nominal exchange rate has significantly depreciated during the study period. This points to the need for a well developed credit market that could serve to safeguard against this and other shocks.

In sum, it is the combination of the domestic marketing costs, import costs, and inappropriate selection of the different fertilizer types that affect negatively and significantly the farm-level price of fertilizers in Malawi. Since Malawi is a price-taker in the world market, the most critical cost element to examine in an effort to improve the terms of trade in favor of crop producers is the marketing costs. In addition, import of ecologically sound and cost-effective fertilizer types has to be adopted.

7.3 CROP PRODUCER PRICES

As indicated earlier in this chapter, the producer prices of maize, rice, and tobacco fell relative to fertilizer input during the entire period under study. This secular decline has turned the terms of trade between fertilizers input and crops against crop producers. This section assesses whether policy reforms initiated in the context of structural adjustment program have contributed to this situation. The section examines the evolution of crop producer prices relative to world prices and relative to the general price level in Malawi.

Table 7.5 shows that the ratio of the producer price over the world price for maize has been consistently greater than one during the entire period, suggesting that the production of maize was heavily subsidized through trade policy. Rice and tobacco were heavily taxed as the ratios of rice and tobacco producer prices over the corresponding world prices were consistently smaller than one. Contrary to maize, rice is not a staple food crop in Malawi. A large share of rice output is exported in the sub-region. Table 7.5 depicts a familiar pattern in Sub-Saharan

Africa. The production of importable crops is generally subsidized through trade and other macroeconomic policies, while the production of exportable crops is taxed.

The study recognizes that in a predominantly agricultural economy, the agricultural sector undoubtfully constitutes the main source of tax revenue. However, it is important to stress that trade taxes (export and import) distort the relative production incentives, and do not constitute an efficient way of raising government revenue. Land, income (wages, dividends, and capital gains) and consumption taxes are the most appropriate.

Table 7.5 also suggests that the producer price of maize cannot be increased otherwise. A liberalization of fertilizer and maize markets will lead to a decline in the price of both maize and fertilizers, but without necessarily leading to any reduction in the price of fertilizers relative to maize. This scenario might have led most policymakers in the Sub-Saharan region to reduce the pace of liberalization and privatization program.

A decline in producer price for maize -- the main source of cash income for most smallholder farmers -- in face of rising cost of living, would further squeeze the income of these poor farmers. In fact, Figure 7.5 reveals that the real price of maize exhibits a declining trend during the 1977-88 period. Its index fell from 102.4 during the 1977-83 subperiod to 82.0 during the 1984-88 subperiod (Table 7.6). Figure 7.5 also shows that their real producer prices of rice and tobacco followed the same trend. The index of real producer price for rice fell from 107.8 to 86.3 and that for tobacco from 108.6 to 93.6 (Table 7.6).

Policy reforms did little to improve the real crop producer prices in Malawi.

Conclusively, the producer price for maize is likely to fall during the process of liberalization and privatization. There is very little the Government of Malawi can do to further increase the nominal producer price of maize. This price is already much higher than the world price. To reduce the farm-level terms of trade between fertilizers and maize crop, efforts should concentrate on improving the fertilizer delivery system. For rice and tobacco, in addition to fertilizer market improvement measures, trade taxes on these commodities should be phased out. Government should raise its revenue through land, income and consumption taxes, instead of trade taxes.

7.4 RETURNS TO FERTILIZER USE

The returns to fertilizer use is defined, as specified in the methodological note, by the value-cost ratio (VCR) of fertilizer used in the production of a specific crop. This variable expresses the volume of crop output or the amount of money attributed to one kg of crop output or one unit of local currency spent on fertilizer input. Mathematically, the value-cost ratio for fertilizers is given by the ratio of crop response to fertilizer use over the farm-level fertilizer-crop terms of trade. The first term represents the volume of crop output ascribed to one kg of fertilizer nutrients used, and the latter term refers to as the cost of fertilizer nutrients expressed in kgs of crop output needed to purchase one kg of fertilizer nutrients. A VCR of 2 is accepted as cut-off point. A value-cost ratio less than 2 makes

the use of the input to be likely unprofitable, while a VCR equal or greater than 2 suggests otherwise.

Due to lack of longitudinal response data, the VCR reported in Table 7.7 are computed assuming that the crop response to fertilizer use is constant during the study period. The effect of weather was taken explicitly into account in the estimation of the maize response to fertilizer use. Figure 7.6 shows the VCR for local, composite, and hybrid maize, rice, and tobacco displayed all a declining trend during the study period. The variable fell from 2.1 to 2.0 for local maize, 2.4 to 2.2 for composite maize, 6.1 to 5.7 for hybrid maize, and 9.9 to 6.3 for rice during the 1972-78 subperiod and the 1979-83 subperiod. It further declined to 1.3 for local maize, 1.5 for composite maize, 3.8 for hybrid maize and 4.7 for rice during the 1984-88 period. With respect to smallholder tobacco, the VCR fell from 1.3 during the 1979-83 subperiod to 1.2 during the 1984-88 subperiod. Clearly, policy reforms did not help improve the returns to fertilizer use.

Since the crop responses are assumed constant over the period, the declining trend observed in the VCR is primarily attributed to the worsening of the farm-level terms of trade between fertilizer input and crops of concern. As suggested earlier, measures to improve the farm-level fertilizer-crop terms of trade have to be pursued vigorously if the use of fertilizers in the smallholder sector is to be enhanced. In addition, efforts should also concentrate on how best to improve farmers' technical skills related to appropriate fertilizer use practices. These efforts are expected to improve the efficiency with which fertilizer input is used and, consequently, the level of crop

response to this input.

Table 7.1: Fertilizer-food crop terms of trade in Malawi

Year	Subsidized fertilizer-maize terms of trade	Non-subsidized fertilizer-maize terms of trade	Subsidized fertilizer-rice terms of trade	Non-subsidized fertilizer/rice terms of trade
	kgs of maize per kg nutrients	kgs of maize per kg nutrients	kgs of rice per kg nutrients	kgs of rice per kg nutrients
1972	4.9	6.5	2.1	2.8
1973	3.6	4.9	2.1	2.8
1974	7.5	9.8	4.3	5.6
1975	6.8	8.8	2.7	3.5
1976	5.5	7.3	2.8	3.7
1977	5.6	7.3	2.8	3.7
1978	5.9	7.8	3.0	3.9
1979	5.8	7.6	2.9	3.8
1980	4.9	6.3	3.4	4.4
1981	5.9	7.6	4.1	5.3
1982	5.4	7.0	5.9	7.7
1983	7.9	11.1	7.3	10.2
1984	8.2	10.8	6.5	8.7
1985	10.0	12.7	7.1	9.0
1986	9.3	11.3	5.9	7.1
1987	9.1	11.9	5.0	6.5
1988	7.2	9.5	4.5	6.0
1972/78	5.7	7.5	2.8	3.7
1979/83	6.0	7.9	4.7	6.3
1984/88	8.8	11.2	5.8	7.5
1972/88	6.7	8.7	4.3	5.6

Sources: Reserve Bank of Malawi, 1990. Financial and Economic Review, Volume XXII-No. 1
David E. Sahn and Jehan Arulpragasam, 1990. The Stagnation of Smallholder Agriculture in Malawi: A Decade of Structural Adjustment. Food and Nutrition Program Unit Cornell University, Washington, D.C. USA.
FAO. 1988 Trade Standard Yearbook.

Note: n.a. means not available.

Table 7.2: Fertilizer-tobacco terms of trade in Malawi

Year	Subsidized fertilizer-smallholder tobacco terms of trade	Non-subsidized fertilizer-smallholder tobacco terms of trade	Non-subsidized fertilizer-estate tobacco terms of trade
1972	n.a.	n.a.	n.a.
1973	n.a.	n.a.	n.a.
1974	n.a.	n.a.	n.a.
1975	n.a.	n.a.	n.a.
1976	1.4	1.8	0.6
1977	1.1	1.4	0.5
1978	1.1	1.4	0.4
1979	1.0	1.4	0.4
1980	1.2	1.6	0.5
1981	1.2	1.5	0.5
1982	0.9	1.2	0.3
1983	1.0	1.5	0.6
1984	1.0	1.3	0.6
1985	1.3	1.6	1.4
1986	1.3	1.5	0.7
1987	1.4	1.8	0.8
1972/78	n.a.	n.a.	n.a.
1979/83	1.1	1.4	0.5
1984/87	1.3	1.6	0.9
1972/87	1.2	1.5	0.6

Sources: Reserve Bank of Malawi, 1990. Financial and Economic Review, Volume XXII-No. 1.
David E. Sahn and Jehan Arulpragasam, 1990. The Stagnation of Smallholder Agriculture in Malawi: A Decade of Structural Adjustment.
Food and Nutrition Program Unit Cornell University, Washington, D.C. USA.
FAO. 1988 Trade Standard Yearbook.

Note: n.a. means not available.

Table 7.3: Structure of NP fertilizer price in Malawi

Cost Items	1987-88		1988-89		1989-90	
	MK/metric ton of Fertilizers	%	MK/metric ton of Fertilizers	%	MK/metric ton of Fertilizers	%
Import Costs	**642.7**	**100.0**	**890.8**	**138.6**	**993.0**	**154.5**
- f.o.b. Durban cost	343.4	100.0	583.2	169.8	630.0	183.5
- external transport	253.0	100.0	296.0	117.0	350.0	138.3
- levy and taxes	36.9	100.0	0.0	0.0	0.0	0.0
- other costs	9.4	100.0	11.6	123.4	13.0	138.3
Domestic Marketing Costs	**71.4**	**100.0**	**269.2**	**377.0**	**285.3**	**399.6**
- interest on working capital[1]	0.0	100.0	142.5	14,250.0	145.6	14,560.0
- direct marketing cost	62.2	100.0	102.5	164.8	111.2	178.8
- other costs	9.1	100.0	24.2	265.9	28.5	313.2
Total Costs						
(ex-retailer)	**714.1**	**100.0**	**1,160.0**	**162.4**	**1,278.3**	**179.0**

Source: Computed from data taken in IFDC, 1989. Malawi Smallholder Fertilizer Marketing Study. Muscle Shoals, Alabama, USA.

Note: NP = 20% of N and 20% of P_2O_5

[1] Note that one was used to compute the percentages.

Table 7.4: Comparison of the prices of fertilizer nutrients from different fertilizer types

Year	Fertilizer prices (t/kg)						Prices of nutrients expressed in percentage of the price of NP, the least expensive type	
	NP		SA		CAN			
	Product	Nutrients	Product	Nutrients	Product	Nutrients	S/A in (%)	CAN in (%)
1972	7	18	6	29	7	27	161.1	150.0
1973	7	18	6	29	7	27	161.1	150.0
1974	18	45	13	62	17	65	137.8	144.4
1975	17	43	11	52	16	58	120.9	134.9
1976	17	43	11	52	16	58	120.9	134.9
1977	17	43	11	52	16	58	120.9	134.9
1978	17	43	11	52	16	58	120.9	134.9
1979	17	43	11	52	16	58	120.9	134.9
1980	17	43	13	62	21	81	144.2	188.4
1981	17	43	18	86	21	81	200.0	188.4
1982	25	63	21	100	26	100	158.7	158.7
1983	29	73	24	114	28	108	156.2	147.9
1984	35	88	27	129	31	119	146.6	135.2
1985	41	103	35	167	38	146	162.1	141.7
1986	42	105	36	171	39	139	162.9	132.4
1987	54	135	46	219	49	175	162.2	129.6
1988	60	150	54	257	55	196	171.3	130.7
1972-78	14	36	10	47	13	50	130.5	138.9
1979/83	21	53	17	83	22	86	156.0	162.3
1984/88	46	116	40	189	42	155	162.9	133.6
1972/88	26	65	21	99	24	91	152.3	140.0

Sources: Based on data from Malawi, 1986. Ministry of Agriculture. Fertilizer Consumption in Malawi Agriculturalists' Report No. 1, Lilongwe. IFDC, 1989. Malawi Smallholder Fertilizer Marketing Study. Muscle Shoals, Alabama, USA.

Notes: t/kg = tambala/kg. NP = 20% N and 20% P_2O_5; SA = 21% N; CAN = 26% N (from 1972 to 1986) and 28% N thereafter 1986.

Table 7.5: Comparison between producer and world prices for maize, rice, and tobacco

Year	Maize	Rice	Tobacco
1971	2.0	0.6	0.3
1972	1.5	0.6	0.4
1973	1.3	0.3	0.4
1974	1.0	0.2	0.2
1975	1.0	0.4	0.2
1976	1.3	0.5	0.2
1977	1.7	0.5	0.2
1978	1.7	0.4	0.4
1979	1.7	0.5	0.4
1980	1.8	0.4	0.3
1981	1.4	0.3	0.2
1982	3.7	0.2	0.1
1983	2.8	0.2	0.3
1984	2.4	0.2	0.3
1985	2.4	0.2	0.6
1986	3.0	0.2	0...4
1987	3.0	0.2	0.3
1988	2.8	0.2	0.2
1989	3.4	0.2	0.2
1971/78	1.4	0.5	0.3
1979/83	2.2	0.3	0.3
1984/89	2.8	0.2	0.3
1971/89	2.1	0.3	0.3

Sources: Based on data from Reserve Bank of Malawi, 1990. Financial and Economic Review, Volume XXII-No. 1.
David E. Sahn & Jehan Arulpragasam, 1990. A Decade of Structural Adjustment; Food and Nutrition Program Unit, Cornell University.
Malawi, 1989. External Trade, National Statistics Office (NSO).
FAO, 1988: Trade Standard Yearbook.

Table 7.6: Evolution of the real producer prices for maize, rice and tobacco

Year	Index of Real Producer Price		
	Maize	Rice	Tobacco
1977	102.0	142.9	105.4
1978	94.1	131.8	128.6
1979	84.5	118.3	112.7
1980	100.0	100.0	100.0
1981	91.2	91.2	93.4
1982	131.1	83.4	89.4
1983	113.5	86.7	130.7
1984	102.5	89.7	106.7
1985	92.7	91.9	114.6
1986	81.4	90.2	96.1
1987	64.9	83.3	82.1
1988	68.7	76.4	70.0
1977/83	102.4	107.8	108.6
1984/88	82.0	86.3	93.9
1977/88	93.9	98.8	102.5

Sources: Based on data from Reserve Bank of Malawi, 1990. Financial and Economic Review, Volume XXII-No. 1.
David E. Sahn & Jehan Arulpragasam, 1990. A Decade of Structural Adjustment; Food and Nutrition Program Unit, Cornell University, Washington, D.C. USA.
Malawi, 1989. External Trade, National Statistics Office (NSO).
International Labour Office, 1987, 1991. Year Book Statistics, Geneva, Switzerland.
FAO, 1988: Trade Standard Yearbook.

Table 7.7: Subsidized fertilizer returns in the production of selected smallholder crops in Malawi

Year	Local Maize	Composite Maize	Hybrid Maize	Rice	Tobacco
	VCR	VCR	VCR	VCR	VCR
1972	2.3	2.7	6.7	12.7	n.a.
1973	3.2	3.6	9.2	12.7	n.a.
1974	1.5	1.7	4.4	6.2	n.a.
1975	1.7	1.9	4.9	9.9	n.a.
1976	2.1	2.4	6.0	9.5	1.0
1977	2.0	2.3	5.9	9.5	1.3
1978	1.9	2.2	5.6	8.9	1.3
1979	2.0	2.3	5.7	9.2	1.3
1980	2.3	2.7	6.7	7.8	1.1
1981	1.9	2.2	5.6	6.5	1.2
1982	2.1	2.4	6.1	4.5	1.5
1983	1.4	1.7	4.2	3.6	1.3
1984	1.4	1.6	4.0	4.1	1.4
1985	1.1	1.3	3.3	3.7	1.1
1986	1.2	1.4	3.5	4.5	1.1
1987	1.3	1.4	3.6	5.3	1.0
1988	1.6	1.8	4.6	5.9	
1972/78	2.1	2.4	6.1	9.9	n.a.
1979/83	2.0	2.2	5.7	6.3	1.3
1984/88	1.3	1.5	3.8	4.7	1.2
1972/88	1.8	2.1	5.3	7.3	0.9

Sources: Based on data from Malawi, 1983. Smallholder Fertilizer Project, Working Papers. Staff Appraisal Report No. 4309 MAI.
Malawi, 1987: Ministry of Agriculture. Fertilizer response in maize: Yields and returns as derived from The Annual Survey of Agriculture. Agriculturalists' Report No. 2 - Lilongwe.
Reserve Bank of Malawi, 1990. Financial and Economic Review, Volume XXII-No.1.
David E. Sahn and Jehan Arulpragasam, 1990. The Stagnation of Smallholder Agriculture in Malawi: A decade of structural adjustment. Cornell University, Food and Nutrition Policy Program, Washington, D.C. USA.
FAO, 1988. Trade Standard Yearbook.

Notes: The value-cost ratio is given as a ratio of crop response to fertilizer use over the subsidized fertilizer-crop terms of trade. The response to fertilizer use is 11.4 kgs of local maize per kg of fertilizer nutrients, 13.1 kgs for composite maize, 33.0 kgs for hybrid maize, 26.6. kgs for local rice variety, and 1.4 kg for smallholder tobacco (dark fired). Due to lack of data, it is assumed that crop responses to fertilizer use are constant over the study period. It is then difficult to assess the effect of policy reforms on this variable.

Fig. 7.1: Evolution of fertilizer-maize terms of trade

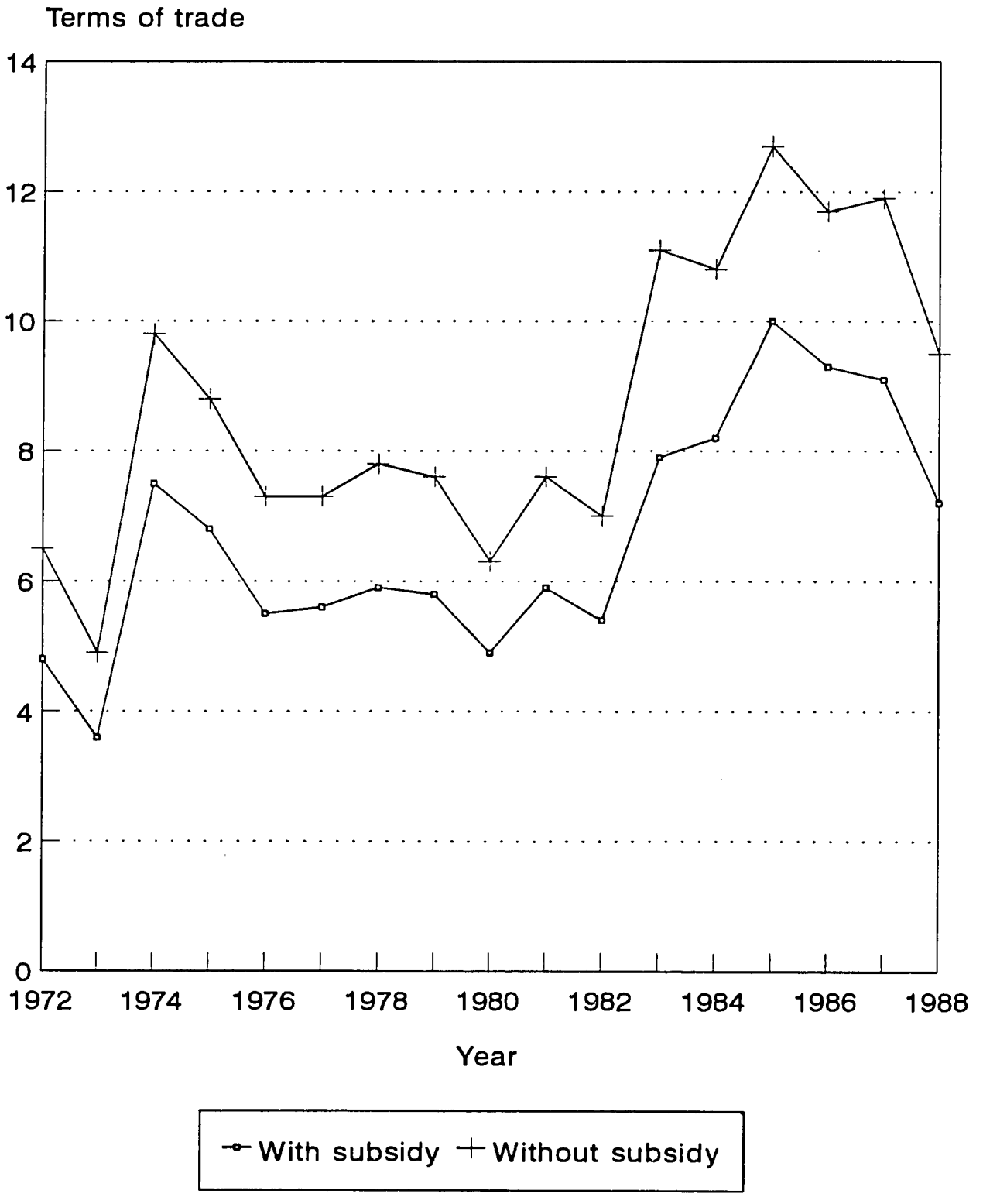


Fig. 7.2: Evolution of fertilizer-rice terms of trade

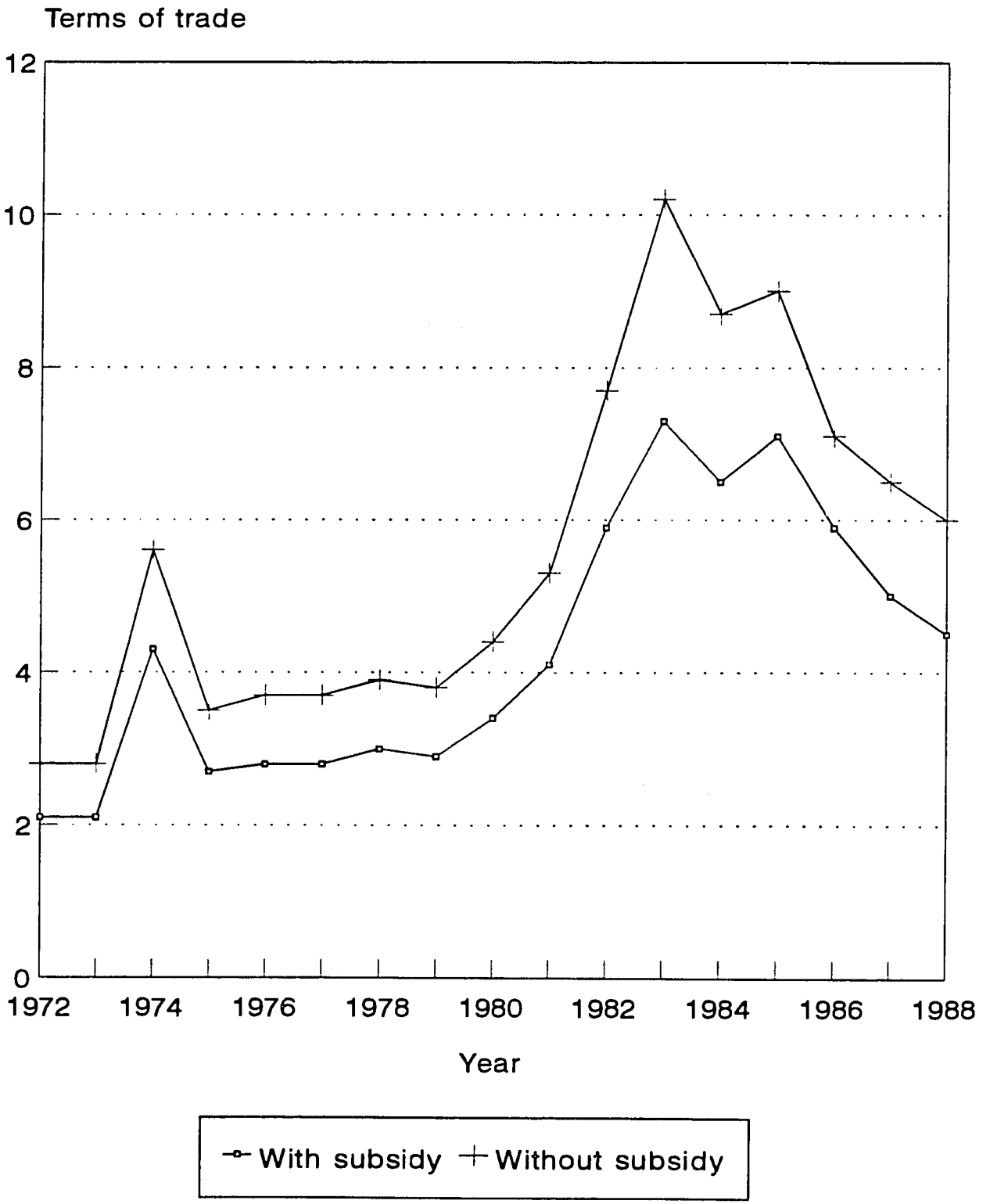


Fig. 7.3: Evolution of fertilizer-smallholder tobacco terms of trade

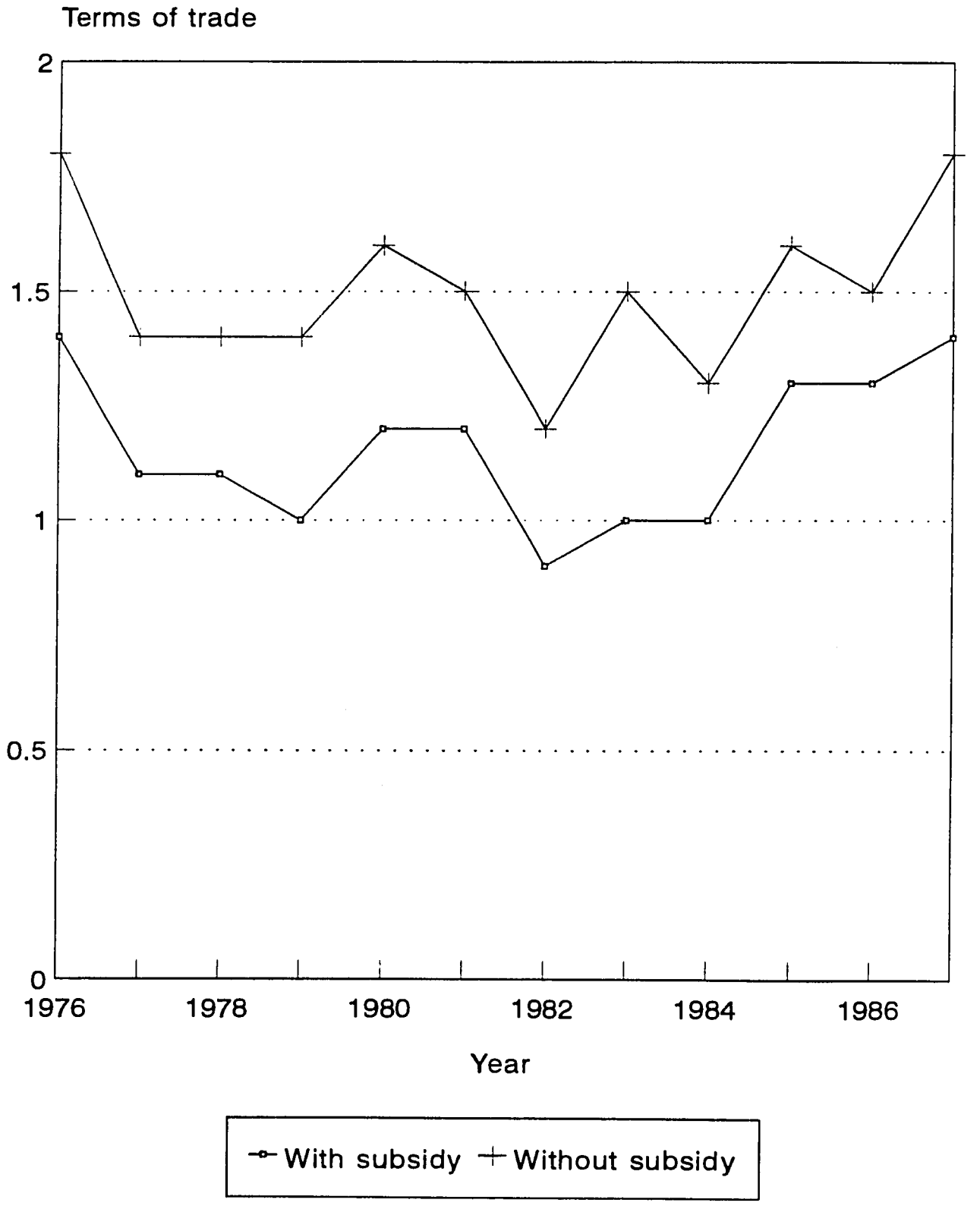


Fig. 7.4: Evolution of nominal exchange rate in Malawi

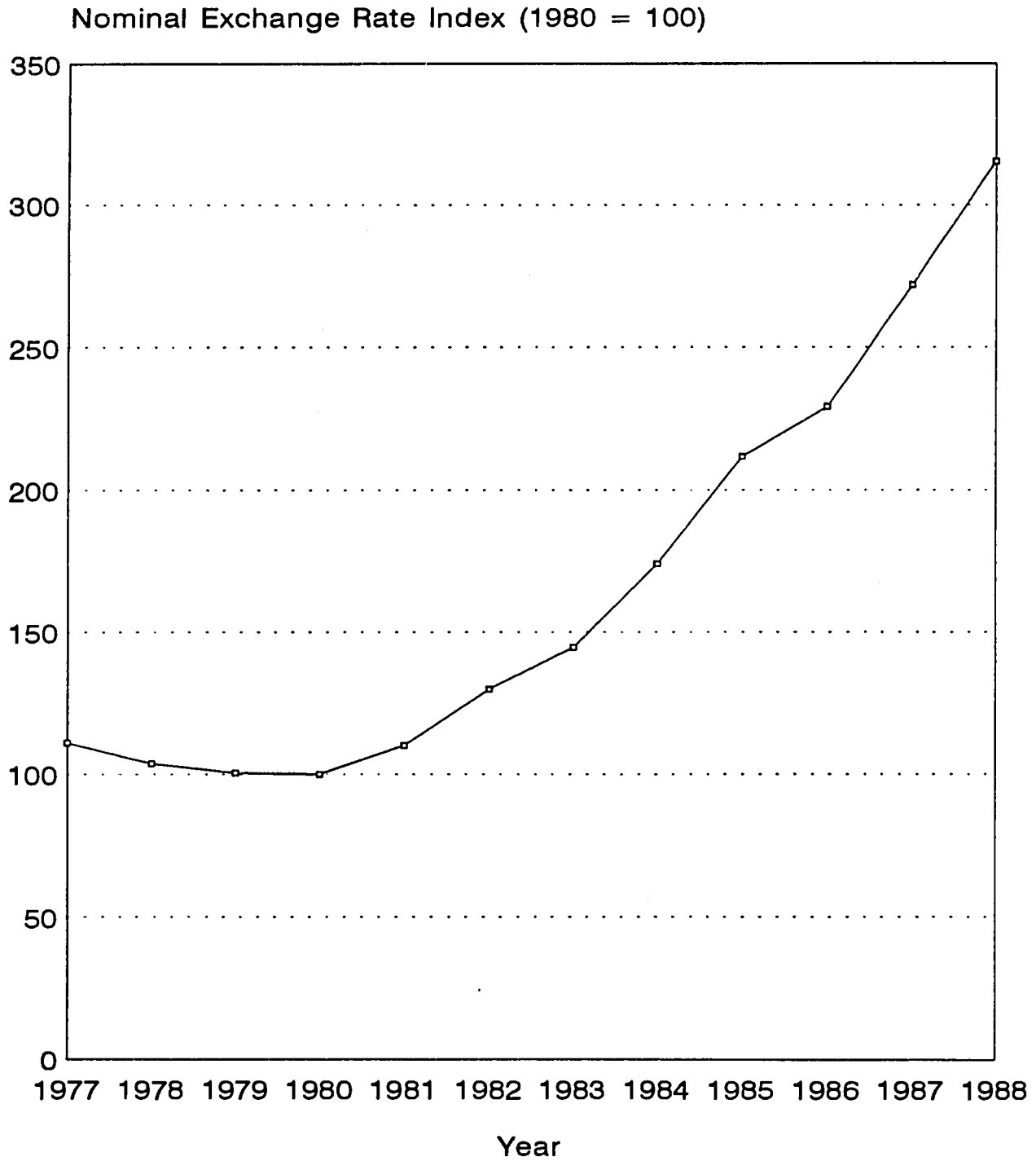
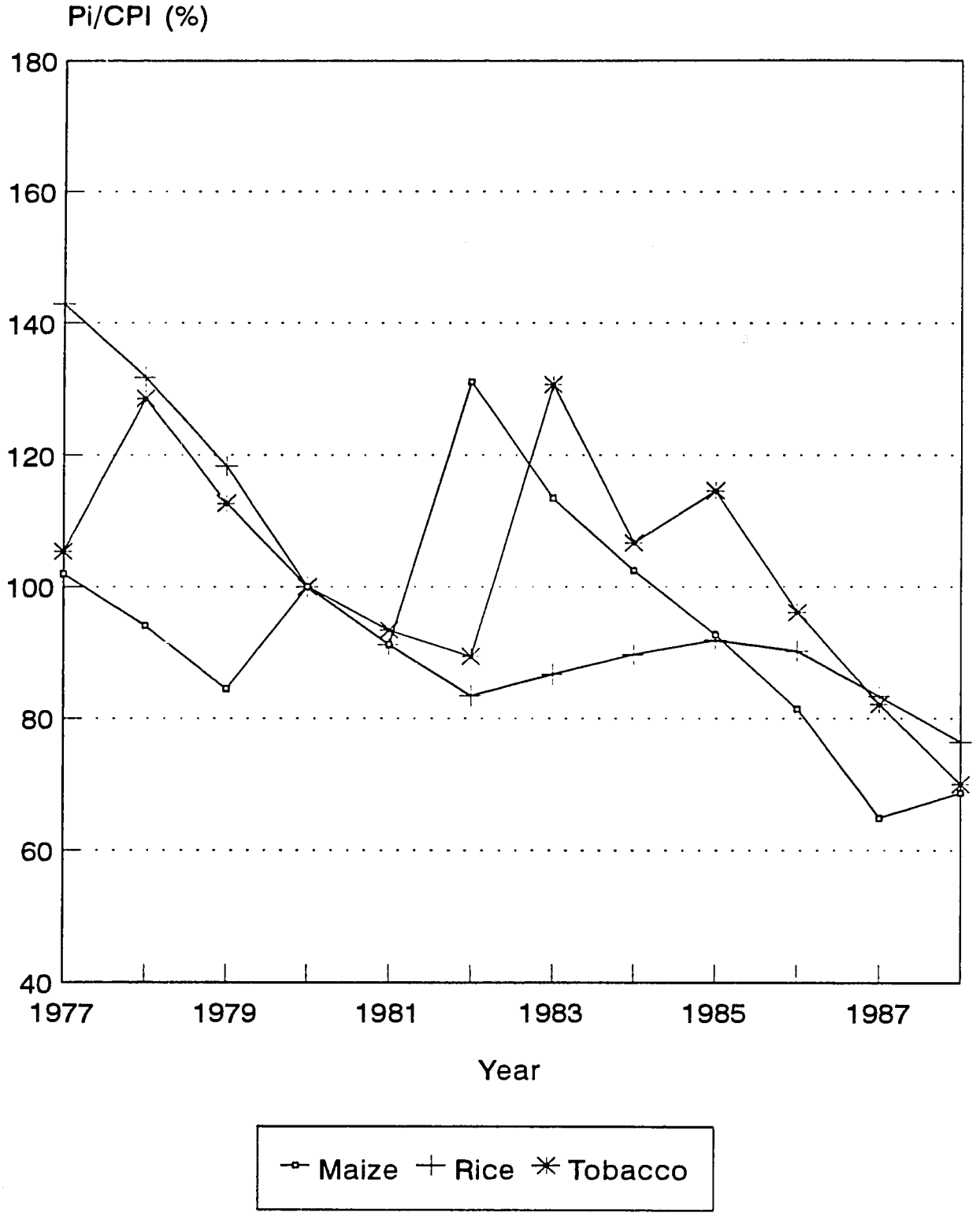
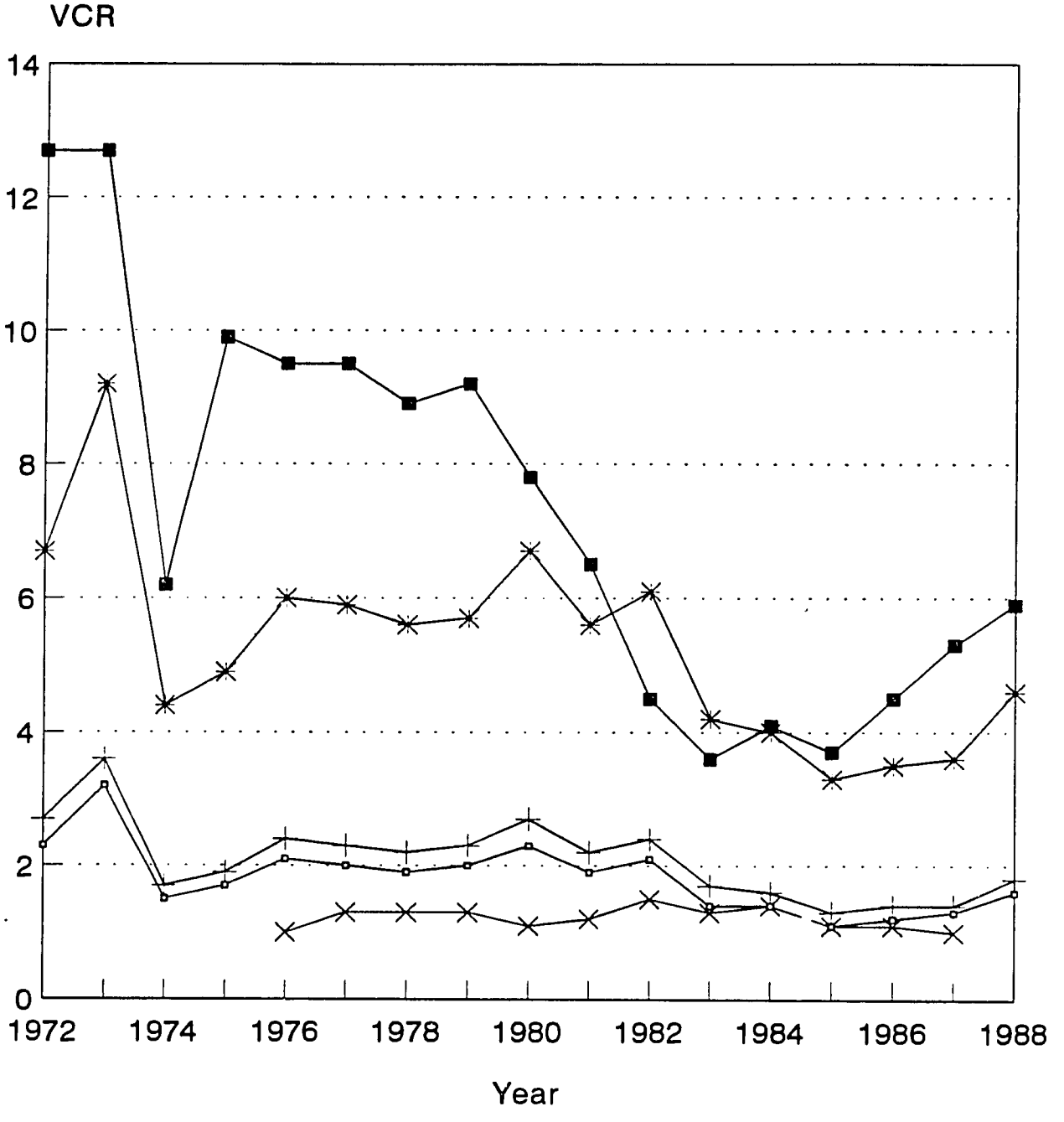


Fig. 7.5: Evolution of Real Producer Prices for Selected Crops



Pi= price of crop i, CPI= consumer price index

Fig. 7.6: Evolution of VCR for selected crops



Local maize | Comp. maize | Hybrid maize
Rice | Tobacco

Comp. = Composite

Annex 7.1: Fertilizer nutrient prices in Malawi

Year	Fertilizer nutrient price for food crops		Fertilizer nutrient price for tobacco	
	Smallholder-level (subsidized) (t/kg)	Retail-level (non-subsidized) (t/kg)	Smallholder-level (subsidized) (t/kg)	Retail-level (non-subsidized) (t/kg)
1972	15	20	n.a.	n.a.
1973	15	20	n.a.	n.a.
1974	30	39	n.a.	n.a.
1975	27	35	n.a.	n.a.
1976	28	37	39	51
1977	28	37	33	43
1978	30	39	44	57
1979	29	38	42	55
1980	34	44	52	68
1981	41	53	51	67
1982	59	77	42	55
1983	87	122	79	111
1984	98	130	75	99
1985	120	153	113	144
1986	111	135	106	129
1987	109	143	127	167
1988	123	161	n.a.	n.a.

Sources: Reserve Bank of Malawi, 1990. Financial and Economic Review, Volume XXII-No. 1.
David E. Sahn & Jehan Arulpragasam, 1990. The Stagnation of Smallholder Agriculture in Malawi: A Decade of Structural Adjustment. Food and Nutrition Program Unit, Cornell University, Washington, D.C. USA.
FAO, 1988: Trade Standard Yearbook.

Note: n.a. refers to not available.

Annex 7.2: Average price of smallholder fertilizer nutrients used on crops

Year	Nutrient Price (T/kg)[1] NP	S/A	CAN	Share of nutrients from different fertilizer types NP	S/A	CAN	Weighted Average Price of Nutrients on food crops (t/kg)	Price of nutrients on tobacco (t/kg)
1972	18	29	27	0.092	0.390	0.069	15	n.a.
1973	18	29	27	0.128	0.363	0.064	15	n.a.
1974	45	62	65	0.104	0.380	0.027	30	n.a.
1975	43	52	58	0.110	0.394	0.037	27	n.a.
1976	43	52	58	0.131	0.390	0.028	28	39
1977	43	52	58	0.136	0.380	0.044	28	33
1978	43	52	58	0.189	0.352	0.055	30	44
1979	43	52	58	0.177	0.357	0.052	29	42
1980	43	62	81	0.204	0.347	0.047	34	52
1981	43	86	81	0.174	0.366	0.030	41	51
1982	63	100	100	0.399	0.227	0.112	59	42
1983	73	114	108	0.472	0.037	0.449	87	79
1984	88	129	119	0.464	0.051	0.427	98	75
1985	103	167	146	0.485	0.036	0.440	120	113
1986	105	171	139	0.403	0.065	0.417	111	106
1987	135	219	175	0.336	0.029	0.329	109	127
1988	150	257	196	0.322	0.051	0.312	123	n.a.

Sources: Based on data from Malawi, 1986, Ministry of Agriculture. Fertilizer Consumption in Malawi. Agriculturalists' Report No. 1, Lilongwe.
IFDC, 1989: Malawi Smallholder Fertilizer Marketing Study; Muscle Shoals, Alabama, U.S.A.

Note: t/kg = tambala/kg

Annex 7.3: Prices of selected crops in Malawi

Year	Producer Prices for Smallholder crops			International Prices for Smallholder crops			International Prices for Estate Crops
	Maize (t/kg)	Rice (t/kg)	Tobacco (t/kg)	Maize (t/kg)	Rice (t/kg)	Fried-cured tobacco (t/kg)	Flue-cured tobacco (t/kg)
1971	4	7	27	2	11	83	91
1972	3	7	23	2	12	62	89
1973	4	7	21	3	22	58	129
1974	4	7	21	4	32	95	149
1975	4	10	24	4	24	147	129
1976	5	10	28	4	19	178	148
1977	5	10	31	3	20	195	172
1978	5	10	41	3	23	107	171
1979	5	10	40	3	21	108	158
1980	7	10	42	4	27	121	101
1981	7	10	43	5	31	175	179
1982	11	10	45	3	58	344	209
1983	11	12	75	4	66	288	187
1984	12	15	75	5	80	251	222
1985	12	17	89	5	98	151	238
1986	12	19	85	4	95	216	288
1987	12	22	91	4	106	325	396
1988	17	27	104	6	165	449	528
1989	24	30	147	7	169	604	479

Sources: Based on data from Reserve Bank of Malawi, 1990. Financial and Economic Review, Volume XXII-No. 1
David E. Sahn and Jehan Arulpragasam, 1990. The Stagnation of Smallholder Agriculture in Malawi: A Decade of Structural Adjustment. Food and Nutrition Program Unit Cornell University, Washington, D.C. USA.
FAO. 1988 Trade Standard Yearbook.

Annex 7.4: Main indices

Year	Official Exchange Rate 1980=100	Rural Wage Rate 1980=100	Consumer Price Index 1980=100	Producer Price of Maize 1980=100	Producer Price of Rice 1980=100	Producer Price of Tobacco 1980=100
1977	111.1	77.36	70.0	71.4	100.0	73.8
1978	103.8	90.57	75.9	71.4	100.0	97.6
1979	100.5	89.94	84.5	71.4	100.0	95.2
1980	100.0	100.0	100.0	100.0	100.0	100.0
1981	110.2	118.87	109.6	100.0	100.0	102.4
1982	129.9	155.35	119.9	157.1	100.0	107.1
1983	144.6	139.62	138.4	157.1	120.0	181.0
1984	174.0	149.06	167.3	171.4	150.0	178.6
1985	211.7	166.04	184.9	171.4	170.0	211.9
1986	229.2	166.04	210.7	171.4	190.0	202.4
1987	271.9	183.02	264.0	171.4	220.0	216.7
1988	315.4	191.82	353.5	242.9	270.0	247.6

Sources: Based on data from Reserve Bank of Malawi, 1990. Financial and Economic Review, Volume XXII-No. 1
David E. Sahn and Jehan Arulpragasam, 1990. The Stagnation of Smallholder Agriculture in Malawi: A Decade of Structural Adjustment. Food and Nutrition Program Unit Cornell University, Washington, D.C. USA.
FAO. 1988 Trade Standard Yearbook.
Malawi, 1989. External Trade, National Statistics Office (NSO).
International Labour Office, 1987, 1991. Yearbook Statistics, Geneva, Suisse.

CHAPTER VIII

OTHER DETERMINANTS OF FERTILIZER USE

Crop response to fertilizer use and fertilizer-crop terms of trade are not the only factors that affect the use of fertilizers at the farm level. Despite a rather acceptable level of returns to fertilizers in the production of hybrid maize and rice, the use of this input in the production of these crops is still limited. Only 25 to 30 percent of smallholder farmers in Malawi use fertilizers (World Bank 1990).[53] As already suggested, the liberalization and privatization of both input and product markets must be carefully examined if efforts to stimulate the production of food and other crops in Malawi are to succeed. Other areas that deserve a critical assessment include credit, research, and extension services.

8.1 AVAILABILITY AND ACCESS TO CREDIT

It is estimated that 55 percent of fertilizer sales to smallholders is on credit and the balance is on cash and the most important source of credit is the credit system available through the ADDs. Services provided through this credit system also include technical advice

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[53] World Bank, 1990. Agriculture Operations Division, Southern Africa Department, Regional Office. Malawi Food Security Report. Report No. 8151-MAI. Washington, D.C.

regarding fertilizer use and cropping patterns. In order to have access to credit, farmer must be a member of a farmers' club. The club applies for seasonal credit on behalf of its members. The credit terms for fertilizer loans are 12 percent per annum with repayment due within one year of the date of the loan. This calculates to be 24 percent a year when repayment is made at harvest (within 6 months). On a 9-month basis the rate is 16 percent. In practice, however, credit is generally repaid after the sale of the produce within 6 to 9-month period. This suggests that the institutional credit is not cheap. The effective rate is even higher than the rate applied to most nonagricultural loans.

Group members are responsible for repayment and exert considerable pressure on club members to repay. Where repayments are delayed, the ADD mount "credit campaigns" in which they seize collateral from farmers, for example, roofing sheets, goats and bicycles. Where the repayment rate falls below 85 percent, the club is declared in default and is not eligible for credit the following season.[54] One consequence is that members are highly selective about whom they admit to the club. Consequently, only a minority of farmers have access to credit. The lack of credit by most farmers has undoubtfully constrained the use of fertilizers and other innovations. The availability and access to credit services are also among the key determinants of fertilizer use in the smallholder sector.

During the 1968/69 agricultural season, the lending volume was K80,000 to 650 smallholders. Ten years later the volume of credit

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[54]Malawi, 1990. Ministry of Agriculture. Smallholder Fertilizers Revolving Fund. Annual Report. Lilongwe.

reached K2.5 million, benefitting approximately 75,000 borrowers (during the 1978/79 season).[55] Despite the increase in availability of credit, most smallholder farmers have not benefitted much from credit services. Clubs generally minimize risks by excluding the smallest smallholders that constitute the largest fraction of the smallholder sector in Malawi. The commercial banks lend only to estate farmers. There are several reasons explaining the exclusion of smallholder farmers from the commercial credit services. Smallholder farmers' lack of collateral and the high transaction costs involved in processing small loans are among the main reasons. In addition, procedures for obtaining bank credit are generally too cumbersome for a largely illiterate rural population.

The Smallholder Agricultural Credit Administrative (SACA), funded by IDA/IFAD, was introduced in 1987/88 to provide funds for financing seasonal and medium-term credit to smallholders and to help run the existent credit systems with better efficiency. Credit and extension services were combined to enhance the production and the recovery rate of the loan. Unfortunately, credit issues have, in many instances, become the only focus of field assistants' work and their success in the field appears to be judged by level of credit recovery.[56] A negative consequence of this credit/extension program is that many farmers feel that if they do not have access to credit then they are excluded from participating in extension activities.

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[55] USAID, 1990. The Malawi Fertilizer Subsidy Reduction Program. The impact of the African Economic Policy Reform Program. CDIE Working Paper Report No. 143, Washington, D.C.

[56] Malawi 1990. Five Year Extension Strategy Plan. Department of Agriculture. January 1990. Lilongwe.

In 1989/90, less than 25 percent of farmers receive credit. Over one-third of farmers in the Northern Region receive seasonal credit compared with 28 percent of farmers in the Central Region and 16 percent in the densely populated south. The Central Region accounts for close to 60 percent of the value of loans, and that almost 60 percent of credit recipients are located in the Central Region. The Southern Region accounts for 48 percent of Malawi's population but receives less than 21 percent of the value disbursed. The access to and geographical distribution of credit to farmers need to be enhanced.

The provision of seasonal and medium-term credit is one of key policy instruments the government has adopted to intensify agricultural production. The Government of Malawi and donors all recognize the need to broaden access to credit to more farmers, and several initiatives have been tried. The credit section in Blantyre ADD is experimenting with the introduction of mini-credit packages in recognition of the fact that the comparatively large size of the credit packages militates against poorer farmers participating in credit clubs. In 1989/90 UNICEF launched a pilot project in Ntchisi where credit packages for fertilized hybrid maize and soyabeans were given to 800 female-headed households with access to less than half a hectare of land. Repayment rates were high, and the project was extended to Mangochi and Nkata Bay in 1990/91.

One of the most critical elements that stimulated the use of high analysis fertilizer is the expansion of access to credit. Yet, the ADD credit system reached only 15 percent of smallholders during 1984-87. This is one of the reasons why SACA cam in to help. During 1989/90,

SACA made some K50 million in new loans to 12,000 clubs with some 300,000 members, representing K4,100 per club, K166 per family. In terms of distribution along gender lines, it is important to note that since 1986, over 25 percent of club members have been households headed by women.

Despite these efforts, the distribution of credit is still biased towards large farmers. About 80 percent of those receiving credit have land holdings of more than one hectare. Therefore, the official smallholder credit program has little impact on the majority of smallholder farmers who have below average resources.[57] These farmers are left with the option of plough-back profits, dependence on relatives, friends, local traders, and traditional money lenders.

8.2 ACCESS TO INFORMATION PERTAINING TO FERTILIZER USE

The extent of technical knowledge acquired by farmers through research and extension services also affect the use of fertilizers and other improved inputs. The technology is transferred to smallholders in Malawi through the Department of Agriculture which is organized into 8 Agricultural Development Division (ADDS), 28 Rural Development Divisions (RDS), 180 Extension Planning Areas (EPAs) and about 1,700 stations from which field assistants carry out extension work. A modified Training and Visit (T&V) system of extension is used in Malawi. Field assistants receive a total of about 30 days of training per year. It is estimated that field assistants spend about 80 percent of their time on knowledge

[57] World Bank 1988. Malawi: Household Food Security. Proposal for a pilot household food security credit Program. Washington, D.C./Lilongwe.

transfer and about 20 percent on credit-related activities.[58] Each EPA is supervised by field officers and field assistants who spread information to farmers by means of block garden demonstrations, club meetings and, more recently in Mzuzu ADD, a supervisory visits to "micro plots" of individual farmers.

Due to donor support, the whole country is reasonably covered by extension staff and supporting infrastructure. Extension agents have tried to deal with the problem of demonstrating the benefits of fertilizer and hybrid seeds, and by organizing credit clubs to give smallholders access to these inputs. However, these initiatives did not meet the conditions and needs of those peasants who have less than average resources. Therefore, the range of effective contact between extension staff and smallholders has been limited to a small minority of well-to-do farmers. As a result, agricultural extension has had little impact on the majority of smallholders who lack resources to purchase inputs or to hire additional labor.[59],[60]

Until recently, research has been focused on single commodity programs located mainly on research stations, while adaptive research systems for the smallholder farmers has received relatively little attention. As a result, both research and extension have been increasingly ineffective, as extension messages have not considered socio-economic constraints facing most smallholder farmers. Despite the

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[58] Tshikala B. Tshibaka, Carlos A. Banante (eds), 1988. Fertilizer Policy in Tropical Africa. Workshop proceedings, IFDC/IFPRI Fertilizer Project, IFDC. Lome, Togo.

[59] Carr, S.J. 1988. Malawi-National Rural Development Program (NRDP) Technical Issues Review, Draft White Cover, August 23, 1988, The World Bank, Washington, D.C.

[60] Trivedy, R. 1988. Investigating Poverty, Action Research in Southern Malawi, Oxfarm Research Papers.

heavy investment in research and extension on improved maize, tardy collation of data and weak research-extension linkages have led to blanket fertilizer recommendations which have become increasingly uneconomic for many farmers. A number of well researched agricultural practices are available but are not promoted by the extension staff, further illustrating weak research-extension linkage. The extension and research staff must work together in identifying farmers' needs, their resources and constraints.

It is evident from the figure on the number of farmers using fertilizers that, a lot more needs to be done to improve the diffusion of fertilizers among Malawian farmers. Extension staff in Malawi have tried to demonstrate the benefit of fertilizer, but have been unable to help the majority of farmers obtain a supply of fertilizers. The main problem that characterizes agricultural extension work at present is its orientation toward large-scale farmers. Women have a major role in farming activities and while more female extension assistants are desirable and being sought, the extension service should, in the meantime, make a greater effort to involve women in direct extension contact and in training activities.

The farm-home assistants should focus their messages more on farming/gardening activities and nutrition. There is no extension service for the estate sector, while this is not particularly important for the older established managers, it is a serious constraint for managers of newly created tobacco estates who have been recently transferred from the smallholder sector. Thus, an extension service for

this group of farmers is needed, but it may be more appropriate for it to be financed by the industry rather than the Government.

CHAPTER IX

CONCLUSIONS AND POLICY RECOMMENDATIONS

9.1. FOOD SELF-SUFFICIENCY AND EXPORT CROP DIVERSIFICATION

Malawi introduced several policy reforms even before SAP in 1981. Therefore, this study covers the 1971-88 period and concentrates on the difficulties Malawi experiences in achieving food self-sufficiency and export crop diversification. These agricultural development goals were to be achieved through intensification of maize production and through the reallocation of farmland away from maize and traditional export crops (tobacco, sugar, coffee, tea) to new export crops. Both the yields of maize and export crops were to be enhanced through a widespread use of fertilizers and hybrid maize variety.

During the pre-adjustment (1971-78) period, the maize yield and area increased respectively at an average annual rate of about 2.1 percent and 0.9 percent. During the adjustment (1979-88) period, maize yield declined at an average annual rate of about 1.9 percent whereas the area under this staple food crop decreased at a very modest average rate of about 0.7 percent per annum. The production of maize did not improve during the post-adjustment (1984-87) period. As expected from SAP, the area under maize decreased by 1.0 percent per annum. This area contraction was accompanied by a 1.5 percent annual decline in maize yield, hence leading to 2.5 percent decrease in maize output per annum.

The deterioration of the maize production was further compounded

during the post-adjustment (1984-87) period by a significant contraction of land area allocated to other food crops and minor export crops, all of which fall under the smallholder farming. These other food crops as well as local maize attract little or no fertilizers as they are primarily subsistence-oriented. Their yields must have declined as most of these minor food crops tend to be cropped on poor land and the fallow system tends to disappear as a result of population pressures on land.

Considering the export crops, the area under predominantly smallholder export crops (groundnut and cotton) declined at a rate of 0.8 percent per year, while the area under predominantly estate crops (tobacco, sugar, tea, and coffee) increased at an annual rate of 2.9 percent during the 1970/88 period. The data indicate that the total area cultivated under nontraditional export crops remains negligible. It is clear from this analysis that the government did not give smallholder farmers—who control, as a group, the bulk of the land—the needed incentives for them to expand their export crop base significantly.

The expansion of the estate sector did not improve the distribution of the increased estate income between capital and labor owners. This situation might have contributed to widespread food insecurity and malnutrition in Malawi because the wage of people working in estate sector and most of whom are members of smallholder farming households declined significantly during the post-adjustment (1984-88) period. The index of the real agricultural (rural) wage, which was 109.1 during the 1979-83 period, declined to 76.3 during the 1984-88

period.

9.2. FERTILIZER USE AND DIFFUSION OF HYBRID MAIZE

A widespread use of fertilizers and hybrid seed has been regarded as the cornerstone of the policy reforms. The overall growth rate in fertilizer nutrient consumption fell from 6.4 percent per year during the pre-adjustment (1972-78) period to -1.2 percent during the adjustment (1979-83) period, and then regained its pre-adjustment level (about 6.6 percent per year during the 1984-88 period). SAP reforms did not significantly improve the consumption of fertilizers.

The distribution of fertilizers among sectors was found to be biased in favor of the estate sector. Taking two major fertilizer-using crops—maize, the most important smallholder crop, and tobacco, the most important estate crop—the available data indicate that during the 1982-88 period, the smallholder sector controlled 71.0 percent of the cropped land area under maize and tobacco combined while the estate sector claimed only 29.0 percent. Yet the estate sector used 48.9 percent of fertilizer nutrients and the smallholder sector 51.1 percent during the period. The diffusion of hybrid maize declined during the 1980-88 period. The share of maize area under local variety rose and that under composite and hybrid varieties fell during the period.

Conclusively, SAP reform did not affect significantly and positively the key factors influencing the use of these inputs in the smallholder sector of Malawi. These factors include, among others, the response of crops to fertilizer input, the farm-level fertilizer-crop

terms of trade, information pertaining to the use of fertilizer and other improved inputs, credit and fertilizer delivery systems, and crop marketing systems.

9.3. MAIZE RESPONSE TO FERTILIZER USE

Data, based on annual survey of agriculture, indicate that the degree of variability in local maize yield, as shown by the coefficient of variation, does not seem to be significantly affected by fertilizer use. The composite variety displays the same characteristic, but to a lesser extent. However, the production of hybrid maize without fertilizers leads not only to smaller yield, but also to high yield variability. This implies that the availability and access to fertilizer input are some of key determinants of the adoption of hybrid maize by smallholder farmers. The development of efficient fertilizer delivery and credit systems are prerequisite to any enhanced adoption of high-yielding varieties.

The regression analysis also reveals that the response of local maize to fertilizer use is about 11.4 kg of maize per kilogram of fertilizer (N and P_2O_5) nutrients, 13.1 kg for composite maize, and 33.0 kg for hybrid maize. The difference between the response of local maize to fertilizer use and that of composite maize is not statistically significant. Furthermore, the analysis indicates that the rates of fertilizer nutrients used by smallholder farmers are about 26.7 kg of fertilizer nutrients per hectare for local, 45.6 kg for composite, and 52.0 kg for hybrid maize. These rates are substantially lower than the

recommended rates of 39.0 kg of fertilizer nutrients per hectare for local, 92.0 kg for composite, and 132.0 kg for hybrid maize.

This analysis further indicates that the rates of fertilizer nutrients used by farmers are technically and economically appropriate. Overall, they correspond to the highest maize response that could be attained given the crop management techniques and other agricultural practices currently used by the smallholder farmers in Malawi. The recommended rates for different maize varieties are too high and make little technical and economic sense.

This result contradicts some researchers who suggest that much effort is needed to encourage most smallholder farmers in Malawi to use the recommended rates of fertilizer nutrients per hectare of fertilized land area. Their conclusion appears not to be based on a rigorous analysis of the farm-level input-output data.

9.4. FERTILIZER-CROP TERMS OF TRADE

The fertilizer price has increased at a rate much faster than the smallholder prices for maize, rice, and tobacco. Consequently, the terms of trade or real price of fertilizers increased. Increases in fertilizer prices at the farm level were mostly due to increased import prices, domestic marketing costs, and external transport costs. The increases in import prices, although substantial, remain relatively much lower than the increases in the domestic marketing costs due to structural and institutional deficiencies. Furthermore, Malawi has largely relied on low analysis fertilizers. A widespread use of high-

analysis fertilizers, consistent with the ecology, will reduce costs at the farm level.

With respect to maize, the producer price of this crop is likely to fall during the process of liberalization and privatization. There is very little the Government of Malawi can do to further increase the nominal producer price of maize. The price paid to producers is already much higher than the world price. For rice and tobacco, the export tax has depressed the prices of these crops at the smallholder farm level.

To reduce the farm-level terms of trade between fertilizers and maize crop, the Government of Malawi should explore the possibility of liberalizing and privatizing the domestic fertilizer delivery and maize marketing systems. For rice and tobacco, in addition to fertilizer and crop market improvement measures, trade taxes on these commodities should be phased out. Government should raise its revenue through land, income and sales taxes, instead of trade taxes.

9.5. RETURNS TO FERTILIZER USE

The returns to fertilizer use, expressed by the value-cost ratio based on average crop response, decreased because of the worsening of the terms of trade between fertilizers and crops. Measures to improve the farm-level fertilizer-crop terms of trade have to be pursued vigorously if the use of fertilizers in the smallholder sector is to be enhanced. In addition, efforts should also be made to improve farmers' technical skills related to appropriate fertilizer use practices.

9.6. OTHER DETERMINANTS OF FERTILIZER USE

In addition to the terms of trade, fertilizer use depends on a broad-based credit system. However, the distribution of formal credit is biased towards large farmers. Most smallholder farmers are left with the option of plough-back profits, dependence on relatives, friends, local traders, and traditional money lenders.

The delivery of information pertaining to the use of fertilizers and other innovations is also a key element in the process of technological transformation of the agricultural sector. Effective contact between extension staff and smallholders has been limited to a small minority of well-to-do farmers.

Research has been focused on single commodity programs located mainly on research stations, while adaptive research systems for the smallholder farmers has received relatively little attention. Both research and extension have been increasingly ineffective, as extension messages have not considered socioeconomic constraints facing most smallholder farmers.

Despite the heavy investments in research and extension on improved maize, tardy collation of data and weak research-extension linkages have led to blanket fertilizer recommendations which have become increasingly uneconomical for many farmers. A number of well-researched agricultural practices are available but are not promoted by the extension staff, further illustrating weak research-extension linkage. The extension and research staff must work together in identifying farmers' needs, resources, and constraints.

Women have a major role in farming and while more female extension assistants are desirable and being sought, the extension service should, in the meantime, make a greater effort to involve women in direct extension contact and in training activities. The farm-home assistants should focus their messages more on farming/gardening activities and nutrition.

There is no extension service for the estate sector; while this is not particularly important for the older established managers, it is a serious constraint for managers of newly created tobacco estates who have been recently transferred from the smallholder sector. Thus, an extension service for this group of farmers is needed, but it may be more appropriate for it to be financed by the industry rather than the Government.

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