

STRUCTURAL ADJUSTMENT IN MALAWI:
THE FERTILIZER SUBSIDY REMOVAL PROGRAM



Acc. No. 728

BY

GEORGE LUKWAGO

A THESIS PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF
SCIENCE

UNIVERSITY OF FLORIDA
1992

Dedicated to my late grandma, Kezia Eron Najjuma of Kawolongojjo-
Mityana in Uganda, and my late brother, Charles D. Kiggundu Batasi.

ACKNOWLEDGEMENTS

I am very indebted to Dr. Christina Gladwin for her guidance, supervision, tireless efforts and admirable patience during this study. Her knowledge of the field of Third World economies and agriculture was very useful in the study. Specifically her knowledge on Malawi was a stepping stone and will always be with me. I thank Dr. Chris Andrew for his guidance in developing this study. His comments always made this study look easier. I appreciate the help of Dr. Peter Hildebrand and the way he gave me access to his work on farming systems in Malawi. I am very proud of the analytical tools that Dr. Ronald Ward took time to teach me, both during his course and during the innumerable times that I bumped into him in his office. His words were always a source of encouragement to me. I am also thankful to the faculty and staff and my friends in the Department of Food and Resource Economics who made this study a success.

My heartfelt thanks go to Ruth Muwonge, who was always available to help me during the entire period that I carried out this study. I also extend thanks to my parents and guardians, Ibrahim Lukwago, Maria Namatovu, Isaac Tamale, Manjeri Nakibuuka, Gertrude Nassali, and Ruth Nnanyunja, who have been my source of courage, aspirations and hope since time immemorial.

I appreciate the numerous messages from Eron Nantumbwe, Susan Nakiyina, Roland Kabuye, Juliana Lubinga, James Kayongo, Peter Sekyanzi,

Catherine Sengooba, and the Lubega family of Entebbe, Uganda. Great appreciation is also extended to Dan Ddamulira, Richard Senyonjo, Felix Nzitatira, Abdul Kasoro, and the family of the late Paul Kiwalyanga of Luzira-Gomba, Mpigi District in Uganda. Thanks also go to fellow Ugandans in Gainesville, Florida, especially Dr. Peter Nkedi-Kizza, Mary Silver, Peter Mijumbi, Jeremiah Lwanga, Sam Mukasa, and Robinah Ssonko, who formed an admirable work group for invaluable ideas. I appreciate the endurance of Norah Nammuddu, Alex Ssali Alidekki, Eddie Lukwago, Milly Namugerwa, and Gloria Nakafeero for enduring till the end of this study. Your prayers were appreciated. I am grateful for the cooperation of the people in IFAS International Programs and the Center for African Studies. Students at the University of Florida from Malawi have also been helpful in this study and therefore deserve thanks. Special thanks also go to Mark Ebaugh of Ohio State University, Reginald Adamus, Thomas Samkyi, Amy Purvis, Bea Cavington, Alden Bell and Brian Hiers of Gainesville, Florida, for their moral support.

Finally, I extend gratitude to the USAID/MFAD Project which financed the study, and the Ministry of Agriculture in Uganda, which gave me an opportunity to study in the U.S.A.

Any errors that may arise are my sole responsibility.

	TABLE OF CONTENTS	PAGE
ACKNOWLEDGEMENTS		iii
LIST OF TABLES		vii
ABSTRACT		ix
CHAPTERS		
1	INTRODUCTION	1
	Objectives	3
	Hypotheses to be Tested	4
2	STRUCTURAL ADJUSTMENT: THE THEORY	6
	Causes for the Poor Performance of Sub-Saharan	
	African Economies	11
	The Rationale Behind SAPs	15
	Arguments Against SAPs	18
	Social Implications of Structural	
	Adjustment Programs in Africa	22
3	THE RESEARCH SETTING: MALAWI	27
	The Land Tenure System and the Evolution	
	of Agriculture in Malawi	29
	Smallholder and Estate Sectors	31
	The Economy	33
	Local Maize vs Hybrid Maize	36
	Fertilizer Use in Malawi	37
	Pricing Policy and Cropping Patterns	41
	Smallholders and Credit in Malawi	44
	The Fertilizer Subsidy and Its Removal	44
4	METHODS AND METHODOLOGY	53
	Data	54
	The Ordinary Least Squares Method	55
	Statistical Models of Qualitative Choice	57
	Supply Response	62
5	THREE SETS OF RESULTS	64
	Results 1: Some Descriptive Statistics	65

	Cropping Systems and Fertilizer Use in Malawi	70
	Results 2: Ordinary Least Squares, Probit, and Tobit Analyses	76
	A Simulation Model	84
	A Comparison of the Three Methods of Analyses	90
	Results 3: An Improved Supply Response	91
	Gendered Impacts	96
6	DISCUSSION AND CONCLUSIONS	98
	Summary of Major Findings	98
	Policy Issues	100
	Recommended Policies to Improve Agricultural Development in Malawi	101
	REFERENCES	110
	BIOGRAPHICAL SKETCH	116

LIST OF TABLES

TABLE	PAGE
2.1 Average Annual Growth Rates of Population and GNP per Capita, in Sub-Saharan Africa, 1965-1987	8
2.2 Sectoral Shares in GDP at Current Prices in Sub-Saharan Africa	10
2.3 Structure of Demand and Percentage Shares in Final Expenditure in Sub-Saharan Africa	10
2.4 Structure of Exports in sub-Saharan Africa and all Low-income Countries	11
3.1 Percentage of Holdings in Malawi by Size of Holdings (ha) . . .	30
3.2 Estimated Population and Distribution in Malawi	30
3.3 GDP Growth Rates in Malawi, 1964-85	34
3.4 Yields of Maize in Malawi With and Without Fertilizer in Different Land Sizes	40
3.5 Fertilizer Use by Smallholders and Estates in Malawi, 1972/73 to 1987/88	42
3.6 Credit Participation and Credit Recovery by Malawian Smallholders	45
3.7 Economic Policy Recovery Program Budget Savings in Malawi (M Kwacha)	47
3.8 Savings Due to Importation of High Analysis Fertilizer instead of Low Analysis Fertilizer in Malawi	48
5.1 Distribution of Land Size by Gender in Malawi	66
5.2 Distribution of "Nocash" by Different Land Sizes in Malawi	67
5.3 Club Membership by Gender in Malawi	68
5.4 Land Sizes and Fertilizer Use in Malawi	69

5.5	Distribution of Smallholders in Malawi by Club Membership and Manure Use in Malawi	70
5.6	Mean Area (ha) of Common Crops in 1986/87 and 1985/86 in Lilongwe, Blantyre, and Kasungu	72
5.7	Average Amount Of Fertilizer Appiled per Hectare On Common Crops in Malawi in 1986/87 and 1985/86	74
5.8	Profitability of Major Crops in Malawi (Kwacha/ha)	76
5.9	Definition of Variables	77
5.10	OLSQ, Probit, and Tobit Estimates for Equation 4.1	78
5.11	OLSQ, Probit, and Tobit Estimates for Equation 4.2	81
5.12	OLSQ, Probit, and Tobit Estimates for Equation 4.3	82
5.13	OLSQ, Probit, and Tobit Estimates for Equation 4.4	85
5.14	Tobit Estimations for Equations 4.1, 4.2, 4.3, and 4.4.	86
5.14	Predicted Amount of Fertilizer with Change in Land Size	88
5.15	Profitability of Common crops in Malawi	92
5.16	Approximate Elasticities of Supply of Local and Hybrid Maize Varieties, 1987/88 and 1988/89 in Malawi	94
5.17	Profitability and Percent Change in Profitability of Selected Crops	97

Abstract of Thesis Presented to the Graduate School of the University of
Florida in Partial Fulfillment of the Requirements for the Degree of
Master of Science

STRUCTURAL ADJUSTMENT IN MALAWI:
THE FERTILIZER SUBSIDY REMOVAL PROGRAM

By

GEORGE LUKWAGO

MAY 1992

Chairperson: Christina Gladwin
Major Department: Food and Resource Economics

The economic crisis of sub-Saharan African countries in the early 1980s has led to the adoption of the Structural Adjustment Programs (SAPs) as a recommendation by international donor agencies such as the World Bank and the International Monetary Fund (IMF), in order to reverse an economic decay in the region. Among the SAP policies are the promotion of tradables as opposed to nontradables, the increase in prices of tradables, and the withdrawal of fertilizer subsidies to farmers. It was hoped that this would eventually initiate more economic activity and, therefore, economic growth in the region. However, because sub-Saharan African economies are dependent on agriculture both for employment and food, these policies have had some adverse effects on agricultural production of African farmers.

Malawi, in Central Africa, is one these sub-Saharan African countries that adopted SAPs in the 1980s. A Fertilizer Subsidy Removal Program (FSRP) has been adopted. Through SAP policies, the government

of Malawi has encouraged the cultivation of cash crops (tradables) such as tobacco, hybrid maize, and cotton, at the expense of subsistence crops (nontradables) such as local maize, which occupy 90% of smallholder farms and are grown mainly by women. Intensive agricultural production by fertilizer use and other appropriate technologies must be encouraged in Malawi because of the country's high population and the low production of local maize, the staple food whose production has stagnated during the past five years.

During the study, the FSRP in Malawi is described, and the program's economics and impact on farmers are analyzed. The major factors limiting smallholders' use of chemical fertilizer were determined to be lack of cash and/or credit. Smallholders who were credit club members applied more fertilizer than nonclub members. The study also indicated that a withdrawal of the fertilizer subsidy from smallholders and, therefore, an increase in fertilizer prices, will lead to less fertilizer use on local maize and, as a result, will not elicit a supply response in local maize production. An increase in the price of local maize cannot offset the increase in fertilizer prices and removal of the fertilizer subsidy. On the other hand, an increase in price and profitability of hybrid maize offsets an increase in the price of fertilizer and removal of the fertilizer subsidy. Women lose out in such a SAP arrangement of promoting only tradables, and hence, SAP policies are gender-biased.

CHAPTER 1 INTRODUCTION

Neglect of the smallholder sector in the past years has led to a decline in the agricultural productivity and per capita incomes of smallholder farmers and agriculture in sub-Saharan Africa. In order to increase agricultural output to ensure food security, smallholders ought to be able to use appropriate new technology and yield-increasing inputs of production. Given the severe population pressure that many sub-Saharan African countries (e.g., Malawi) are now facing, increasing productivity through fertilizer use among smallholders must be prioritized (FAO 1984). Lele (1989: 13-14) wrote:

A major factor in the effort to raise crop yields [in sub-Saharan Africa] is the availability of and application of fertilizer, especially under conditions of heavy population pressure on land and dwindling reserves of uncultivated arable land. Given the growing land pressure, limited purchasing power of rural households and the rising food and fertilizer prices, a subsidy on fertilizer for the benefit of resource-poor is critical to ensure their food security.

However, the withdrawal of fertilizer subsidies in several sub-Saharan African countries has either already occurred, or is being seriously considered by the international donors under Structural Adjustment Programs (SAPs).

SAPs advocate the removal of price distortions within an economy. Examples are overvalued exchange rates, low interest rates, and artificially low food prices, and an overall minimization of government involvement in most of the public economic sectors. Promoting the

private sector, as SAPs' advocates urge, would increase agricultural output and encourage efficient resource use. This is achieved through the promotion of tradables as opposed to nontradables. The price of fertilizer under SAPs would be determined by market forces and the price of maize and other crops would be raised, reflecting their international demand. In Malawi, for instance, it had been hoped that smallholders would adopt the cultivation of hybrid maize which has been shown to respond better to fertilizer than "local" maize varieties.

Unfortunately, the adoption of hybrid maize has been extremely low and now represents only 5% of the maize-growing areas (Lele 1988). Most rural households still grow the traditional local maize, most of which is consumed in the household. As a result, most of the available fertilizer is expected to be applied to local maize. Because most smallholders in Malawi are discouraged by government policies promoting the growth of high-valued export crops such as burley tobacco, tea and sugarcane, these farmers have put most of their land under local maize. Since most of this maize is consumed, and farmers have little additional land to grow other cash crops, their incomes have remained very low. Due to low levels of alternative production resources (land, off-farm income), these farmers have found it difficult to afford the high price of fertilizer without a subsidy and/or credit. Malawi's Fertilizer Subsidy Removal Program (FSRP) thus affects the food security of individual households and possibly that of the nation at large.

Objectives

This study thus aims to:

- 1) provide a general description of SAPs in sub-Saharan African countries and in Malawi in particular;
- 2) provide a description of the FSRP in Malawi;
- 3) analyze the economics of the FSRP in Malawi and evaluate its impact on farmers; and
- 4) determine the major factors that limit smallholders' use of chemical fertilizer in Malawi.

In short, this study strives to evaluate SAPs in sub-Saharan Africa by looking at one SAP in one sub-Saharan African country--Malawi. The study attempts to answer such questions as: What are the impacts of SAPs on smallholder farmers? Are they positive or negative? Are implemented SAPs identical to or different from theoritized SAPs? Are SAP policies applied in Malawi expected to provide incentives for smallholder farmers, and what are the desired effects of these policies? Are there any negative effects associated with these policies and, if so, why?

This study does not intend to seek a total evaluation of the structural adjustment program in Malawi; rather, it aims to show the implications of the structural adjustment program's goals to withdraw the fertilizer subsidy from Malawi's smallholders. Studies have shown that maize and other crops are fertilizer responsive and any change which results in decreased fertilizer use will lead to reduced agricultural output (Gladwin 1989a). It is argued that if no fertilizer

subsidy is available, smallholders will use little to no fertilizer because it is too expensive. The removal of the fertilizer subsidy will work against an expansion of local maize production, an expansion made necessary by an influx of approximately 3 million Mozambican refugees into Malawi, coupled with an increasing internal population growth rate, and the first signs of a lack of food self-sufficiency in Malawi. These factors could threaten food security in Malawi. There will be a need to import maize from elsewhere. The cost of importing such maize will be much greater than that of subsidizing fertilizer, because of the high transport costs due to the cutting of the Beira railway line in Mozambique.¹

Hypotheses to be Tested

To achieve the objectives of this study, several hypotheses will be tested.

1a) The quantity of fertilizer a farmer uses is determined in part by his or her access to cash or credit; access to credit is determined by membership in a credit club. The main factor limiting fertilizer use in Malawi is not profitability of maize production but, rather, smallholders' access to cash and credit.

1b) Those farmers who are club members use more fertilizer than non-club members.

2) Smallholders, faced with a fertilizer subsidy removal program and an increase in the price of fertilizer, will prefer to use fertilizer on hybrid maize which is the men's cash crop, rather than local maize,

¹ The civil war in Mozambique has led to the destruction of the Beira railway line that used to transport commodities from the Indian Ocean to Malawi. Malawi now uses the Port of Durban in South Africa.

which is a subsistence crop and traditionally the responsibility of women. Hybrid maize responds more to chemical fertilizer than local maize.

3) An increase in the price and profitability of local maize will not elicit an increased supply response of local subsistence maize because it is not usually sold. It is, rather, a nontradable commodity. Therefore, increasing the price of local maize will not offset the rise in the price of fertilizer under the FSRP for farmers growing local maize.

4) Increasing the price of hybrid maize (a men's cash crop) will elicit an increased supply response. This is because hybrid maize is a tradable and a profitable cash crop. Therefore, an increase in the price of hybrid maize will offset increases in the price of fertilizer and the removal of fertilizer subsidy for farmers growing hybrid maize.

5) Because women grow local maize and men grow and sell hybrid maize, a fertilizer subsidy removal program is not gender neutral. It is gender-biased. If SAPs are successful in switching resources from nontradables to tradables, then women lose out.

The organization of the thesis is as follows. Chapter 2 reviews the rationale of SAPs in sub-Saharan African countries, as well as the arguments put forward against them. Chapter 3 examines the situation specific to Malawi which serves as a research setting for an analysis of how such policies actually impact on African farmers. Chapter 4 describes the methods and data; and Chapter 5 presents the results. Chapter 6 gives the summary of the findings, policy implications, and conclusions.

CHAPTER 2 STRUCTURAL ADJUSTMENT: THE THEORY

The Structural Adjustment Programs (SAPs)--naturally defined to include IMF-supported stabilization and World Bank-supported adjustment programs--have generally had three principle objectives:

- 1) Balance national expenditures and national income
- 2) Effect the efficient allocation of resources by switching them across economic sectors
- 3) Mobilizing more resources over longer terms to increase rates of economic growth and standards of living, particularly for the poor (ECA 1989).

SAPs policies are geared to the belief that a variety of both macro and micro economic policies will lead to attainment of the above goals and, therefore, a government's success in these programs will depend on the best combination of policies chosen. Since 1980, many African countries have adopted these adjustment programs. Between 1980 and 1988, thirty-three states have concluded a Standby Arrangement Facility (SAF) with the international donors. Twelve sub-Saharan African countries have had the Extended Fund Facility (EFF) from the IMF, while fifteen have had Structural Adjustment Loans from The World Bank (ECA 1989). These Structural Adjustment Loans included funds from the International Development Association (IDA) which covered the group of African states that were least able to resist the ill effects of the decline in terms of trade of the 1970s. In addition, Official

Development Assistance (ODA) increased its capital inflows in the region particularly in 1987 when the sponsors of ODA increased their donations by 13% from the original figures of 1983. These ODA funds were provided by bilateral donors such as USA, UK, Canada, and Sweden as well as the multilateral agencies like the World Bank, the IMF and the United Nations Development Program (UNDP). In particular, the multilateral donor agencies increased their ODA disbursements by 12% per year between 1983 and 1985, and 13% per year in 1986 and 1987 (World Bank/UNDP 1989). The Special Facility for Africa (SFA) operated between 1985-1988 was meant to adjust financing and mobilized almost US \$2 billion in direct donor contributions and bilateral joint co-financing through the World Bank's Joint Program of Action for sub-Saharan Africa (World Bank/UNDP 1989). The IMF's Structural Adjustment Facility (SAF) offered grants to low-income countries. The IMF also established an enhanced SAF in 1987 which was meant to reduce or reverse the negative net financial flows from sub-Saharan Africa.

Agriculture is the most important economic activity in the sub-Saharan region; therefore, it is worthy of note to briefly mention the effects of these loans and policies on food and cash crop production. In those countries that liberalized export producer prices, a number of rural farmers increased their incomes up to 1987; thereafter, these incomes declined due to excessive currency devaluation. Although food production increased during the early stages of these reforms, poor marketing policies led such surpluses to depress prices in 1985 and 1986. By 1987 there was a contemporaneous rise and fall in cash and food crop production, respectively.

For the purpose of this study, it is important to look at causes for the poor performance of economies of sub-Saharan African countries since 1973. This poor performance eventually culminated in the introduction of Structural Adjustment Programs. These economies gradually weakened as a result of both internal and external factors. A summary of the economic performance of sub-Saharan economies from the time of independence until 1987 is given in Table 2.1.

Table 2.1 Average Annual Growth Rates of Population and GNP per Capita, Sub-Saharan Africa, 1965-1987.

	1965-73	1973-80	1980-87
GDP	5.9	2.5	0.5
Population	2.6	2.8	3.1
GNP Per Capita	2.9	0.1	-2.8

Source: World Bank 1989a: 221, 222, 269.

The period 1965-80--the period preceding the Structural Adjustment Programs--shows a reasonably satisfactory overall economic growth of almost 6% per annum up to the first "oil shock" of 1973. Although the population growth rate was 2.5% per annum, the difference between economic growth and population growth provided for a sound rate of growth in per capita incomes.

Such a difference would imply that sub-Saharan Africa was moving toward structural transformation during this period. Structural transformation is defined as a rise in the relative importance of the secondary (manufacturing) sector and a decline in the share of the primary (agricultural) sector in total national output and employment (Johnston and Kilby 1975). During structural transformation, a slight

increase in the relative importance of tertiary services and a shift from low productivity informal sectoral activities to modern transport, finance, insurance, and others is indicated. GDP rises because of an increase in investment and savings due to productive increases in exports. Therefore, structural transformation is both a consequence and a cause of economic growth (Johnston and Kilby 1975) and is, at the same time, an integral component of long run development. During structural transformation, the share of expenditures for food consumption declines with rising incomes. Because the demand structure also changes with development, consumption for processed food products, manufactured goods, and services also increases. Factors of production are then allocated to sectors where productivity is highest, i.e., in secondary and tertiary services. Johnston and Kilby (1975) underscore the importance of agriculture in late developing countries in facilitating this process of structural transformation.

Soon after the oil shock of 1973, there was a drastic decrease in the economic growth rate; coupled with an increased population growth rate, the growth rate in per capita income turned negative while the income and consumption per capita stagnated. As a result, there was little or no structural transformation in sub-Saharan African economies (Tables 2.2 and 2.3). Although there was a marked decline in the share of agricultural production between 1965 and 1980, the corresponding rise in the share of the secondary and/or the industrial sector was however, due to the oil boom in the mining sector, rather than an increase in manufactured goods and services (O'Brien 1991). In fact, the manufacturing sector as a fraction of GDP did not increase at all during

this period and, as a result, sub-Saharan Africa's share of the world manufacturing value stagnated at 0.8% between 1960 and 1975 (Meier and Steel 1989).

Table 2.2 Sectoral Shares in GDP at Current Prices in Sub-Saharan Africa.

	1965	1980	1987
	(percent)		
Agriculture	43	30	34
Industry (including mining)	18	33	28
(Manufacturing)	(9)	(9)	(9)
Services	39	37	39

Source: World Bank 1989a: 224-225

Table 2.3 Structure of Demand and Percentage Shares in Final Expenditure in Sub-Saharan Africa.

	1965	1980	1987
	(percent)		
Consumption	82	79	87
(Government Consumption)	(10)	(13)	(16)
(Private Consumption)	(72)	(66)	(71)
Growth Domestic Investment	14	20	16
Growth Domestic Saving	14	22	13
Exports (Goods and NFS)	22	26	26

Source: World Bank 1989a: 165.

In most of sub-Saharan Africa, the domestic manufacturing sector declined during the second half of the 1970s; capacity exceeded domestic demand in many subsectors and Africa's highly protected infant

industries could not compete internationally in export markets because of their high cost structures. Investment productivity of the 1970s did not lay the ground needed for future economic growth in both agriculture and manufacture. Export stagnated during the 1970s and Africa's share of world trade declined as a result. As exports further declined, the region's share of world market decreased tremendously from 2.7% in 1960 to 1.7% in 1987 (Svedberg 1987). Because sub-Saharan African countries mostly export primary products, their world market shares in the majority of these primary products has been dwindling. Nonetheless, Africa's dependence on primary product exports has been greater than that of other low-income countries as shown in Table 2.4.

Table 2.4 Structure of Exports in Sub-Saharan Africa and all Low-income Countries.

Exports	(percent)					
	Sub-Saharan Africa			All Low-income Developing Countries		
	1965	1980	1987	1965	1980	1987
Fuels, minerals metals	34	71	47	22	58	29
Other primary products	58	25	39	53	23	22
Total	92	96	86	75	81	51

Source: World Bank 1989a: 194-195

Causes for the Poor Performance of Sub-Saharan African Economies

A large body of literature explains the causes of the failure of African economies. The World Bank's special reports (World Bank 1981, 1984, 1986) identify the neglect of the agricultural sector as the most

important cause for this failure. Through the inefficient and high-cost marketing parastatals, government monopolized the marketing of export crops where farmers (producers) were given prices far below those of the international market (Bates 1981). Also, pricing policies in the food sector were set in favor of the urban dwellers, at the expense of the rural farmer. Price controls on domestic food crops became negative agricultural incentives and more than offset the positive incentives in terms of credit and subsidies on inputs such fertilizers. Thus, as agricultural output and growth declined neither could offset the increasing population rate. Massive importation of food together with the stagnation of export volumes led to decreased foreign exchange earnings. Lack of increased demand in the rural sector due to smallholders' low incomes meant a poor market for the domestic manufacturing sector which, in turn, could not finance import requirements, particularly in the wake of the diminishing foreign exchange earnings from primary product exports.

ECA (1989: 2-8) summarizes the causes of the sub-Saharan economic crisis in the decade of the 1980s as a combination of both internal and external factors. Some of the internal factors mentioned include: a narrow production base with ill-equipped technology; an over-dependence on subsistence agriculture; the urban bias of public policies; weak linkages between the modern formal sector and a growing informal sector leading to a dualistic economy; and poor institutional management. Timmer, et al. (1983), include another set of internal factors based on distorted "macro prices". These distorted macro prices (overvalued exchange rates, low interest rates, artificially low food prices,

subsidized input prices, and high wages) send critical signals that may negatively affect the efficient allocation of resources, and cause stagnation of the food supply system as well as the economy as a whole, in the long run. In particular, overvalued exchange rates make imported capital goods and inputs relatively cheaper than the domestically produced substitutes and domestic labor.

External factors in the 1970s and early 1980s included the oil price hikes of 1973 and 1979, along with the collapse of world prices for primary (agricultural) commodities which accounted for most of Africa's exports, and led to declines in Africa's terms of trade since 1981. All these factors contributed to the doubling of Africa's total debts, resulting in the total evaporation of commercial lending flows into Africa. Further, donor agencies reduced loans or switched to grants. Africa's economic performance was, therefore, "particularly dismal" with an average annual GDP growth rate of only 0.4% during the period 1980-87; and per capita incomes, already low in comparison to those of Asia and Latin America at the end of the 1970s, steadily declined by 2.6% per annum during the 1980s (ECA 1989: i). At the same time, Africa's physical and social infrastructure (education, public health and sanitation, housing and potable water) have rapidly deteriorated. As the economic crisis grew more severe, an increasing number of sub-Saharan African countries, unable to sustain these economic and financial imbalances, had no better alternative than to adopt SAPs in order to become competitive again. SAPs are defined by Berg (1989: 1-2) as:

Changing the structure of production so that the adjusting economy produces more tradables--import substitutes and

exports--....Restoring equilibrium to the balance of payments is still an important element in the theory and practice of structural adjustment....It means the adoption of measures designed to make an economy more productive, more flexible and more dynamic by using available resources more efficiently...The importance of domestic policy deficiencies is more explicitly recognized....Structural adjustment in the 1980s has invariably meant the introduction of more market-oriented policies-- liberalization of markets, more efficient use of prices, greater openness, and a bigger role for the private sector.

SAPs have been explained or promoted as a way to re-activate the already stagnating agricultural and industrial sectors of Africa's economies (Due 1991, O'Brien 1991). SAPs prescriptions believe in the neo-classical assumption of free markets. These markets are assumed to be competitive; thus, their signals are supposed to be good guides to efficient resource allocation. The ultimate aim of structural adjustment is to create a free market--introducing market liberalization reforms, adjustment of prices, limitation of trade barriers, and a larger role for the private sector.

SAPs have energetically addressed imbalances of payments in sub-Saharan African's proposed monetary and fiscal policies. The monetary policies call for the removal of ceilings on exchange rates in order to streamline commodity prices, both imported and exported, with those of the world market. Fiscal policies, on the other hand, aim at promotion of the private sector, reduction of government expenditures in public enterprises, and an efficient tax base. These monetary and fiscal policies, SAPs advocates urge, would lead to: 1) the eventual elimination of balance of payments deficits; 2) increased production in both agriculture and manufacture; 3) an efficient allocation of productive resources; 4) increased earnings to both agriculture and

manufacture leading to more investment. Increased investment implies increased economic activity and, therefore, more output.

The Rationale Behind SAPs

In the wake of Africa's economic crisis, African countries have had no choice but to seek assistance from the developed countries (U.S.A., Canada, and Western Europe), and from multilateral agencies, specifically the International Monetary Fund and the World Bank. To ensure that borrowers are able to repay, lenders have set pre-conditions for assistance. These pre-conditions involve a massive devaluation of a borrower's currency, decontrol of prices, and removal of restrictions on imports and foreign exchange. It is hoped, through SAPs, that such measures will lead to increased production and productivity, efficient use of resources and stable supply and demand. SAPs encourage incentives to allocate resources to production of goods and services that are internationally tradable instead of goods and services that are not internationally tradable (Elson 1991).

The macroeconomic framework of SAPs assumes that land and labor are exclusively used to produce either tradables or nontradables. While tradables are exportable, nontradables are consumed within the producer country. Prices of tradables, under this arrangement, are determined by the world market through world supply and demand forces. These prices cannot be influenced or manipulated by any one producer country or agent. Prices of nontradables are determined by supply and demand within a country. Export crops--cocoa, coffee, cotton, rice--, clothing, machine equipment, and services (such as tourism) are tradables. Nontradables include import substitutes, subsistence crops

grown by smallholders for household consumption, and government supported public services such as education, health, research, and infrastructure.

Due to control of prices and foreign exchange in sub-Saharan Africa, there has been a bias against the production of tradables. Price levels of tradables have been lower than those of nontradables. Such policy-induced price distortions lead to the overproduction of nontradables and underproduction of tradables (Elson 1991). The underproduction of tradables leads to reduced exports and, therefore, reduced foreign exchange earnings creating a balance of payments deficit. Such a trend, SAPs advocates insist, must be reversed to favor instead the production of tradables. By introducing a number of free market policies, prices of tradables would be higher than those of nontradables. This, in turn, will induce producers to switch resources to produce more tradables than nontradables (Streeten 1989, Elson 1989) and, in consequence, lead to an outward movement of the production possibilities curve to the optimum point where opportunity cost is equated to price. There would then be more income, and people's demand for consumption goods would rise, promoting higher investment and resulting in an increase in GNP. This is why SAPs introduced monetary and fiscal macroeconomic policies that were meant to encourage the economic re-allocation of resources. In particular, prices of tradables paid to farmers were increased to reflect world market prices; prices of nontradables were significantly reduced, and local currencies were devalued. Subsidies on food and on inputs such as fertilizers were

reduced or completely withdrawn in the long run. Interest rates on loans were increased.

The question to ask at this point is how such an arrangement of resource-switching is derived. By comparative statics, a pattern of production and pricing in a model is comparable to a similar pattern of production with different pricing in another model. If relative prices are changed, the pattern of production also changes (Elson 1991). During such a change, structural barriers of labor transfer from one pattern of production to another are assumed to be non-existent and costless. Also, labor is taken to be abundant. Other assumptions include prompt response of supply and demand to market signals, and minimum disturbance from social, political and institutional forces.

Many African countries at first resisted adopting these SAPs and instead resorted to excessive external borrowing, printing excess money, and arrears accumulation. O'Brien (1991) explains that by the time SAPs were introduced, the economic and financial crisis in sub-Saharan Africa was producing an atmosphere whereby food prices skyrocketed, real wages fell, and there was an escalation of public debt. In addition, exports and imports diminished due to overvalued exchange rates, which in turn significantly reduced the volume of foreign exchange. The highly protected, import-dependent industrial sector became inefficient, depending on subsidies and unable to compete in the international market. This led to overburdened government budget deficits. The SAPs' measures introduced by the IMF and the World Bank were dictated by the nature and severity of the crisis and in the absence of any other means of addressing such imbalances. This only happens if the structure of

production is changed such that there are higher rates of productivity growth across the secondary sector and optimal allocation of resources to these frontiers of production. O'Brien (1991) calls for commitment by sub-Saharan African countries and hopefully notes that with time, these SAPs can be useful, citing a substantial annual growth rate of 4.3% by SAPs adopters in 1988-89. O'Brien (1991: 41) and the World Bank (1989b: 62) argue that SAPs are a necessary but insufficient condition for structural transformation; nonetheless, they are "important first steps in the right direction."

Arguments Against SAPs

There is little doubt that the economies of Africa in the early 1980s needed a sound adjustment and stabilization program, which SAPs seemed to provide. However, some SAPs policies and assumptions have been criticized due to their failure to address the social costs of adjustment, especially in relation to the poor and other vulnerable groups who comprise the majority of Africans (e.g., Cornia et al. 1987, ECA 1989, Due 1991). Lele (1991) sees very limited response by women and the rural poor to improved prices, if broader issues of agriculture and gender are not addressed. The productivity of labor in agriculture is indirectly affected by the SAPs policies of disinvesting in education, research, and health services. Gladwin (1991) underscores the importance of fertilizer in the economic life of smallholders in Malawi and Cameroon and attacks the fertilizer subsidy removal programs under SAPs as politically-inspired, rather than economic undertakings, and she sees a fertilizer subsidy as the only obvious strategy for food security. Although increases in prices under the SAPs policies are

applaudable, other nonprice measures (e.g., the development of infrastructure to get produce to markets, technology to improve on agricultural production and productivity, access to credit, and efficient markets) would be beneficial.

Undesirable side effects of SAPs due to inflation are also likely to occur if an increase in agricultural prices is communicated to the rest of the economy by an equal or greater increase in the prices of industrial goods. If such industrial goods are agricultural inputs, agricultural production will decrease because farmers will not be able to afford these inputs at higher prices. This, in turn, will affect their consumption patterns. For instance, if the price of fertilizer is raised, then farmers will cut down on the amount of fertilizer used. Consequently, they will produce less. If such farmers earn their incomes primarily from agriculture, their incomes are decreased. This leads to a fall in consumption. If a country is dependent on agriculture, exports will dwindle and foreign exchange earnings will decrease. This will then affect the country's ability to import goods, and may cause default on international loan payments. This effect is likely to be more profound if devaluation raises input prices long before higher prices on output are perceived. In a situation where wages are frozen, farmers may be reluctant to raise market output levels. SAPs have tended to ignore these issues.

In sub-Saharan Africa, the distribution of factors of production, especially land, is skewed against the rural poor and women. The ability of such people to switch to tradables is limited if they were not initially producing tradables. Switching to tradables only benefits

the owners of factors of production which are used to produce tradables. Because of the sexual division of labor in sub-Saharan Africa, there is a structural barrier and, therefore, a cost during transfer of resources from nontradables to tradables (Elson 1991). The owners of the factors of production for nontradables are likely to lose income due to a decrease in prices of nontradables. Consumers of nontradables stand to gain in such a circumstance (Streeten 1989).

Greene (1989) sees the SAPs' aims as macro, monetary and short run and, therefore, contrary to agricultural policy and pay-off which are basically micro, real, and medium to long term. Such a model, he insists, is not suitable for sub-Saharan Africa where agriculture is the most important economic activity. Although it is true that macroeconomic policy will have a big impact on agricultural performance, a concentration on monetary instruments and indicators, and a neglect of household performance is not appropriate (Lele and Meyers 1989). There is a need in such a situation to monitor the ability of households to acquire inputs, improve on consumption levels, and gain access to markets. The SAPs concentration on agriculture has only been limited to nominal prices of outputs and cannot, in its entirety, be extended to measure effects on smallholders due to fertilizer subsidy removal and decreases in public services. With an emphasis on aggregate supply, SAPs approach is not likely to raise agricultural production in the long run. SAPs policies obscure other targets that are appropriate in order to improve on individual household agricultural performance. These targets include effective access to credit, research findings,

extension, and improved transport, all of which determine an individual's supply response.

A continuous devaluation of African currencies and a concurrent increase in interest rates lead to low savings. In agriculture, this limits smallholders' abilities to acquire capital on credit. On the national level, the country will fail to respond to new opportunities in both domestic and export markets.

By SAPs standards, based on comparative advantage, export crops are generally favored over food crops. This then means that sub-Saharan Africa is in a better position to increase outputs of coffee, cotton, tea, pyrethrum and sisal, rather than maize, cassava, potato, and other household subsistence crops. The increased prices of exports under SAPs policies raise the value product for labor of export crops instead of food crops. This leads to a compromise when African labor ought to be invested in export crop production. However, given the fact that African farmers are risk averse (Mellor 1984), their ability to invest in export crops is determined by the degree of food security on the household level. Food productivity in Africa has always been low and because the majority of African labor is already invested in food production, many African countries face a dark future in food supply and food security unless food productivity is increased. The withdrawal of fertilizer subsidies will only make the situation worse. Dwindling foreign exchange earnings due to the volatility of international markets for Africa's export crops has reduced the continent's ability to import enough food.

Social Implications of Structural Adjustment Programs in Africa

Nominal incomes of farmers who grow tradables have been raised as a result of price increases. Yet, due to excessive inflation of local currencies and the fall in world prices of primary commodities, real incomes have been reduced. Agricultural production, exports and GDP are reported to have increased in sub-Saharan African countries that adopted SAPs (Lele and Nyaku 1991). In Ivory Coast, there was an improvement in per capita income household expenditures during 1968-87 (Grootaert and Kanbur 1989). While it is difficult to link SAPs macro policies with micro level outcomes (household level), the effects of fertilizer subsidy removal and the resulting labor distribution between tradable and nontradable crops provide good information to this effect. This is more observable in situations where there is an unequal distribution of resources such as land, and where crops grown are gender specific. These will determine the ability of smallholders to respond to SAPs policies. The question then is: How does a smallholder respond to increased cash crop prices but still meet household food requirements? There is, therefore, a direct link between SAPs and household food security.

A household's ability to respond to market incentives is determined by the availability of and access to resources. Households with small landholdings (less than one hectare) will not respond to such incentives because these farmers must give priority to food production. Women, for example, have always given priority to household food security which, in turn, has limited their supply responsiveness to price increases. In a situation where a household is not food

sufficient, consumption decreases (Webser et al., cited in Mehra 1990). The fact that women have always grown nontradables whose prices decreased under SAPs means their incomes have been low. This is also true in households whether male- or female-headed, who grow only food crops due to insufficient land. With such low incomes, these households cannot afford to buy farm inputs such as fertilizer. This does not increase agricultural productivity and, in situations where the majority of farmers in a country are of low income, national food security is threatened. SAPs policies have led to the increment of farm input prices, and a withdrawal of input price subsidies, a situation that will lead to less food production and consumption.

In addition, lack of access to credit by most households means they cannot buy the necessary inputs such as fertilizer since initially their incomes are low. This is more so in rural Africa where there are biases to agricultural credit against smallholders and women to agricultural credit (Staudt 1982). Under structural adjustment, policy changes which led to the removal of credit ceilings and raised the demand for money were introduced. Subsequently, interest rates have been increased. Smallholders cannot afford these high interest rates, and even if they could, they cannot offer land as collateral. Informal credit, which has been a major source of credit for the rural poor, is reported to have become tighter during adjustment (Mehra 1990). The demand for labor rose during structural adjustment as households tried to expand production or adopt new tradable crops. Due to the unequal and always unfavorable division of labor against women, as is the African custom, women, despite time constraints, have to provide the

additional labor required by men. This means the production of crops (mostly food crops) grown by women will decrease, thereby reducing the food security of households (Mikell 1986).

In Malawi, where smallholders cannot grow most of the tradables, adjustment policies always will leave them at a disadvantage. As prices for consumer goods go up, wages are frozen, and "the cost-sharing" expenses in hospitals and schools are introduced, along with a deterioration in rural infrastructure, smallholders cannot save. The removal of subsidies on consumer goods and farm inputs implies that many households either have to do without or cut back on consumption. It is important to analyze the aggregate supply response of smallholders to SAPs policies. If smallholders cannot sufficiently respond to higher prices because of constraints (higher input prices, lack of credit), then the removal of these constraints will do more good to agriculture than a policy of merely increasing producer prices (Chhibber 1989). The degree of emphasis given to each factor depends on the relative magnitude of the aggregate supply elasticity with respect to price and nonprice factors. For example, although higher farm prices induce greater effort and better management in farm production as well as higher use of inputs (Chhibber 1989), many tangible nonprice constraints, such as availability of credit and fertilizer, cannot simply be removed by raising prices. Availability of subsidies on inputs, which is a "public good", can only be achieved by public policy and not by higher farm prices, which only benefits farmers who already have input factors to start with. Such farmers do not need further price incentives. In Malawi, where there are two distinct agricultural

sectors (the smallholder and estate sectors) within which there are small informal subsectors, smallholder farmers would not have inputs such as fertilizer because of an increase in input prices. On the other hand, the estate sector stands to gain. This then leads to a big yield gap in favor of the estate sector.

Although price-policy reforms would help maintain the smallholders' incomes in sub-Saharan African countries that have adopted the SAPs, a number of issues must be faced in assessing the effectiveness of this approach, the most important of which is whether or not smallholders are able to produce a marketable surplus above their current consumption. In Malawi, a majority of the rural households have not been able to produce such a surplus. Therefore, higher producer prices will not have a significant impact on the income of such farmers who market very little output, and who produce mainly for their own consumption. The ecological region also determines whether a farmer will grow a cash crop whose price has been increased by SAPs. Because African agriculture is rain fed, types of crops to be grown are determined in part by the climate of a given area. Therefore, even if crop prices have been raised, the climate may not be conducive for such crops (Addison and Demery 1989).

The distribution of productive assets is a powerful determinant of the distribution of marketable surpluses and, therefore, a good social indicator of SAPs. This distribution can be across households or within a household itself. This in turn determines income gains. In Malawi, for example, because smallholders possess less land, they cannot grow high-valued crops and barely have a market surplus. In addition,

female-headed households have less land than their male counterparts. In such a situation, with large inequalities in the ownership of productive assets and where a number of households depend partly on the market for meeting their food requirements, there is a real danger that raising food prices to encourage production may have detrimental effects on the rural poor.

During policy analysis, new and existing data are analyzed on specific topics such as resource distribution, food security, the effect of subsidies on agricultural inputs such as fertilizer, access to and availability of credit to farmers, and other issues that are relevant for assessing the social dimensions of adjustment. The policy questions addressed are as follows: What are the impacts on the smallholder farmers of the SAPs and practices actually implemented? Are the SAPs put into practice similar to the advocated theoretical SAPs, or are there differences? Are there side effects of implemented SAPs which threaten to undo the theoretical benefits? If so, what are they?

To answer these questions, SAPs are described in general and one such SAP in particular, the Fertilizer Subsidy Removal Program (FSRP) implemented in one sub-Saharan African country, Malawi, in Eastern Africa. Before the FSRP is described, a brief look at Malawi's economy and rural infrastructure is in order.

CHAPTER 3

THE RESEARCH SETTING: MALAWI

Malawi is a small country, occupying the southern part of the East African Rift Valley, lying between 9 degrees and 17 degrees south of the equator. It approximates the size of the state of Mississippi in the U.S. It has an area of 119,140 square kilometers of which 20% is under water. Malawi is a landlocked country, bordered by Mozambique on the south and east, Zambia on the west, and Tanzania to the north and west. Topography varies from the Rift valley floor at almost sea level to mountains rising to 3000 meters. The climate and vegetation ranges vary. Lake Malawi is the biggest lake in the country located in the north western part, while River Shire drains from Lake Malombe into the Zambezi. Malawi has three seasons, a cool dry period from mid-April to mid-August, a hot period with little humidity between August and mid-November, and a period of tropical rains between November and April. Within this broad pattern are areas with microclimates, with annual rainfall totalling 300 mm up to 2500 mm. However, there is only one rainy season per year in which farmers can grow any crops they may desire.

Because of the variety of land form and climate, Malawi has the capability to grow a wide range of crops. Maize, groundnuts, rice, pulses, sweet potato and cassava are the most common staple foods, while tea, tobacco, sugarcane and coffee are mainly grown by estates and, to a lesser extent, by smallholders, primarily for export. Malawi is densely

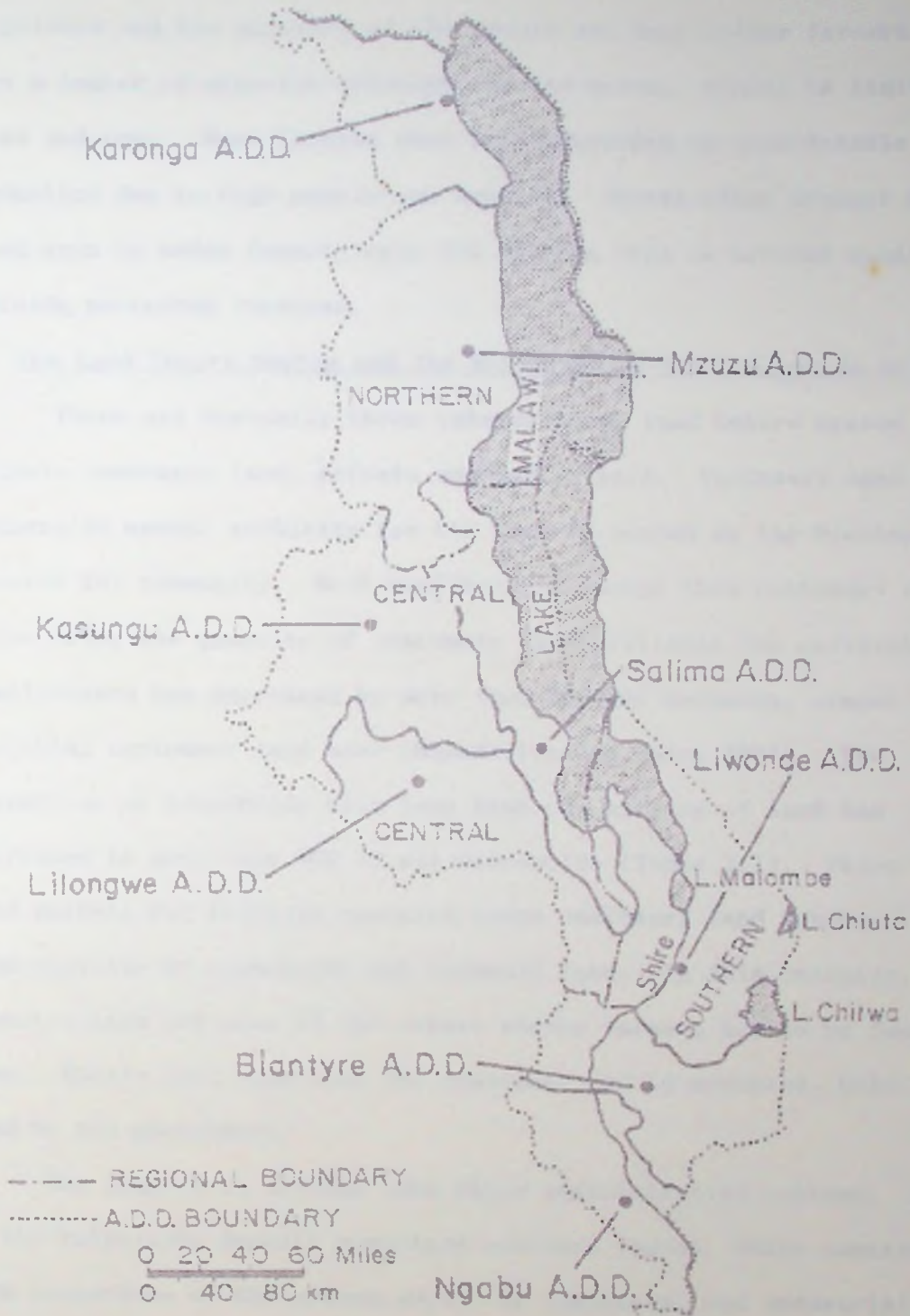


Figure 3.1. Map of Malawi Showing Agricultural Development Divisions (ADDs).

populated and the majority of the people are smallholder farmers. There are a number of minerals although, at the moment, mining is limited to lime and coal. Most forests have been subjected to considerable reduction due to high population density. Thirty-eight percent of the land area is under forest; only 17% of this area is natural woodland outside protected reserves.

The Land Tenure System and the Evolution of Agriculture in Malawi

There are basically three categories of land tenure system in Malawi: customary land, private and public land. Customary land is communally owned; authority for the land is vested in the President as trustee for community. Most smallholders occupy this customary land. Since 1964, the quantity of customary land available for cultivation by smallholders has decreased by more than 70,000 hectares, almost 10% of the total customary land area (Mkandawire and Phiri 1987). The proportion of households with less than one hectare of land has increased to more than 50% of all households (Table 3.1). There are no land markets for holdings operated under customary land tenure. Private land consists of leaseholds and freehold land. In this category, a land market exists and most of the estate sector farmers are to be found here. Public land comprises the remainder and is occupied, held, or used by the government.

The country is divided into three administrative regions. First, is the relatively densely populated southern region, which contains a high proportion of the modern sector of commercial and industrial activity, with its supporting infrastructure. The old administrative capital, Zomba, is in this region and Blantyre is the commercial center.

The fertile central region is well populated. Lilongwe is its center as well as the new administrative capital of Malawi. The third northern region relatively mountainous, infertile and sparsely populated. The total population of Malawi is estimated at just over 7 million and growing at 3.2% per year (Table 3.2). Approximately 50% of the population is under 15 years old and 51.8% are female.

Table 3.1 Percentage of Holdings in Malawi by Size of Holdings (ha).

	under 0.5	0.5- 0.99	1.0- 1.49	1.5- 1.99	2.0- 2.99	over 3
All Malawi ^a	23.5	31.4	19.0	10.7	10.4	5.0
Population (%) ^b	19.3	29.3	19.4	11.7	12.7	7.6
Mean area per resident	0.08	0.21	0.32	0.43	0.56	0.71

^a This survey sampled households operating agricultural holdings, thus the landless households were excluded from the sample.

^b Residents on holdings includes all individuals irrespective of age, living in the household operating the holding.

Source: National Sample Survey of Agriculture 1980/81, Vol.1, Tables I.11 and I.12, NSSA, Zomba.

Table 3.2 Estimated Population and Distribution in Malawi.

	Urban	Rural	Total	Sq.km of land
Northern	90,000	730,000	820,000	30,000
Central	225,000	2,475,000	2,700,000	74,000
Southern	450,000	2,970,000	3,480,000	10,7000
Total	765,000	6,235,000	7,000,000	21,1000

Source: Statement of Development Policies 1987-1996, Republic of Malawi, 1987: Table 1.1.

Of the estimated 1985 labor force of 2,777,000, about 409,251 were registered as having formal paid employment, 46.2% were in agriculture and fishing, 14.6% in manufacturing, and 13.9% in community and personal services (Statement of Development Policies, Malawi 1987). The majority of the unregistered labor force was involved in smallholder agriculture.

Smallholder and Estate Sectors

Malawian agriculture is divided between two sectors: the smallholder and the estate sectors. Most of the large estates existed before 1960, but many were also established on a leasehold basis in the mid 1960s and since then have had the advantages of liberal tax, trade and payment arrangements. These estates have easy access to inputs and grow most of the export crops, which cannot be grown by smallholders due to government restrictions. Two-thirds of the agricultural exports come from the estate sector. On the other end are smallholders who produce the bulk of the agricultural output. Smallholders are characterized by small pieces of land and a small stock of capital. They account for 4/5 of all agricultural production and meet the country's demands for staple foods (pulses, sweet potatoes, maize, cassava, groundnuts) as well as providing some agricultural raw materials, mainly sun and fire cured tobacco (Hinderink and Sterkenburg 1987). They possess handhoes, cutlass, machetes, and axes as farm implements. Smallholders are basically subsistence farmers, consuming almost all their farm produce and sometimes buying additional food to supplement their own subsistence food crops. Women have always been responsible for the food security needs of the family, while men have tended toward the production of cash crops or off-farm activities (Ghai and Radwan 1983). In fact, due to

low production, and therefore, low incomes, smallholders have sought off-farm work, in some cases employment on estates. Few purchased inputs are used by smallholders due to their limited incomes. Although the estate sector contributes only 20% of the agricultural output, it accounts for over 2/3 of all exports, in the form flue-cured and burley tobacco, tea and sugar (Statement of Development Policies, Malawi 1987).

In 1971, the Malawi Government established highly capitalized, integrated rural development projects in different areas of the country, aimed at promoting the marketing of surplus food (rice, pulses, maize) and export crops (coffee, cotton, groundnut, tobacco). Other, less important, objectives of the projects included soil conservation, promotion of agro-based activities and social and physical infrastructure. The focus, however, went to those farmers who had already achieved a relatively high level of production--the so called "progressive farmers"--before the creation of the projects (Hinderink and Sterkenburg 1987). As a result, the estate sector together with this "progressive" sector, produced an impressive agricultural output leading to lop-sided agricultural development in the mid 1970s.

Realizing that the future of these projects was uncertain, the Malawi Government formed the National Rural Development Program (NRDP) with the objective of raising smallholder production and productivity. The program encouraged diversification of farm production and provided the basics of social and physical infrastructure. The benefits of this program, however, accrued to the estate sector through the government's producer pricing policy on smallholders. Virtually no new technology was adopted by smallholders (Lele and Meyers 1989).

The outcome has been increasing social inequality between the smallholder and estate sectors. The estate sector receives higher prices than their counterparts (except for a few crops recently approved by the SAP); they grow export crops not allowed by a majority of smallholders; they receive more customary land originally meant for smallholders. Additionally, they have access to soft term credits from the Agricultural Development and Marketing Corporation (ADMARC), the sole marketing board. ADMARC is owned by the government and buys all the produce of smallholders. The estate sector is allowed to look for a conducive market for its output.

The Economy

In 1986, Malawi's Gross Domestic Product (GDP) was estimated at K Million 2621 (2621 M "Kwacha") or K347 per head (US \$155).² Agriculture employs about 85% of the population and contributes 37% of the GDP. Since the majority of the labor force is still in agriculture, not much structural transformation has occurred. The growth rate of subsistence agriculture is well below the population growth rate of 2.9% per annum. Given such a low agricultural growth rate, the share of agriculture in the economy fell from 51% in 1970 to 40% in 1987, while that of commerce rose from 10% to 17%. The share of the Gross Domestic Investment in GDP rose from 16% in the late 1960s to 29% by the 1970s with the share of the Gross Domestic Savings rising from 5% to 13% of GDP. Real GDP grew at 6.1% between 1970 and 1978, with a corresponding real GDP per capita growth rate of 3.2% (Table 3.3). In spite of a high rate of economic

²This discussion on the economy uses much of Chapter 2 of "Statement of Development Policies 1987-1996", Republic of Malawi.

growth throughout the 1970s, Malawi faced a constantly growing deficit in balance of payments accounts. As imports exceeded exports, deficits on both factor and nonfactor services accounts increased. The trade deficit was widened by the fall of tobacco and tea prices and rising import costs in the 1970s of essential commodities and services

Table 3.3 GDP Growth Rates in Malawi, 1964-85.

	1964-69	1970-78	1979-81	1982-85
Real GDP	4.3	6.1	1.7	3.0
Real GDP per capita	1.4	3.2	-1.3	-

Source: Statement of Development Policies 1987-1996, Republic of Malawi 1987: Table 2.2.

such as fuel, fertilizer and transport. The increase in transport costs, coupled with a decline in migrant worker remittances, led to a notable deterioration of the services accounts.

Migrant worker remittance income, the second important source of foreign exchange after tobacco, was extremely reduced in 1976 and 1977 due to a government policy which discouraged labor migration to mines in South Africa. The overall effect on the economy was compounded by the cutting of the Beira line through Mozambique during the Mozambican civil war. All imports had then to be shipped through Durban, South Africa, sharply raising freight costs in Malawi's external trade. Despite such uncomfortable economic trends, there was significant economic growth (8%) in 1978. Until 1979, Malawi enjoyed a good economic atmosphere. Economic growth averaged 7% per annum, and foreign budgetary assistance was totally eliminated by 1972/73. The 1979-81 period was dominated by serious economic setbacks and a decline in per capita incomes. Malawi,

in this period, experienced a sharp reduction in growth, deteriorating financial positions for a wide range of public and private enterprises, and a rapid exacerbation of balance of payment pressures (Christiansen and Kydd 1987, Lele and Meyers 1989). This situation was due to:

- a) The deterioration in external terms of trade from 1977 and thereafter. Lowest prices for tea and tobacco were accompanied by swift increases in import costs, especially in fuel, fertilizer and transport costs. By 1980, the external terms of trade index had fallen to 50% of the 1970 level.
- b) The low rainfall in the 1979/80 season significantly reduced total crop production which in turn led to increased food imports. Real GDP fell by 0.6% in 1979, 3% in 1980 and 3% in 1981.

The balance of payments current account deficit seriously widened from about 9% in the early 1970s to an average of 23.5% in 1979 and 1980, which led to further external borrowing. By 1980, the external debt service charge was Kwacha 51.7 m, a debt/GDP ratio of 18.7%. It was during this period that the Structural Adjustment Program (SAP) was introduced to, among other things, improve production incentives, and re-order public expenditure priorities.

In summary, the oil shock of 1979, as well as a fall in the price of tobacco (Malawi's major source of export earnings), resulted in an economic crisis where the current account deficit and the debt service ratio further increased. The drought that struck the country in the mid 1980s necessitated food imports. The influx of refugees from neighboring Mozambique, together with an increase in transport costs, led to further economic imbalances. In order to maintain its real

income, Malawi had to produce an even larger volume of exports due to the decline in its international terms of trade in 1987 (Lele and Meyers 1989). Because of all these problems, Malawi adopted the Structural Adjustment Program (SAP) financed mainly by the World Bank to a tune of \$224 million from 1981 to 1989 in an effort to improve on its balance of payments, and to decrease the budget deficit. The SAP would lead to a free market, decontrol of prices, and appropriate allocation of resources during production. As in the rest of sub-Saharan African countries, SAP in Malawi led to: 1) increase in producer prices; 2) a devaluation of the kwacha; 3) a decrease in public expenditure; 4) and a decrease in the fertilizer subsidy, a subsidy which would eventually be eliminated.

Although by 1987 there had been an improvement in the debt/service ratio and other macro indicators, agricultural output of most crops either stagnated or decreased, and real per capita income showed no improvement (Lele 1988).

Local Maize vs Hybrid Maize

Local maize is the staple food of Malawi and is grown by most smallholders for household consumption. Due to the low agricultural productivity, most of the land of smallholders is planted in local maize. Hybrid maize is also grown, but mainly for sale. Smallholders prefer to consume local maize to hybrid maize because local maize is a flint, while hybrid maize is a dent. There is little loss of local maize during pounding; it is resistant to moisture and pests during storage, and can be stored longer than hybrid maize. In fact, many farmers have expressed a special attachment to local maize and would not

give it up easily, "even if they had access to flint hybrid" (Jones and Sakara 1991). Very little fertilizer is applied on local maize (see below). Agricultural policy has favored hybrid maize at the expense of local maize. Extension services have encouraged farmers to adopt hybrid maize with little success. Research is mainly on hybrid maize and hybrid seeds are readily available. The fertilizer subsidy was first attached to hybrid seed, i.e., a farmer could only receive the subsidized fertilizer if he or she had received hybrid seed in the first place. Later, the subsidy was extended to an input package for local maize production because it comprises of 95% of total maize production.

Fertilizer Use in Malawi

Since 1973, fertilizer use in Malawi has been increasing for both smallholders and the estate sector. From 1973 to 1981, there was a rapid adoption of fertilizer with an average rate of growth of about 13% per year. Malawi has been using mostly three types of fertilizer, namely 20:20:0, calcium of ammonia (CAN) and sulphate of ammonia (S/A). However, because of its tendency to acidify soils, the importation of sulphate of ammonia has been reduced in favor of CAN. Also, with the introduction of hybrid maize, the use of 20:20:0 has increased. Again, during 1986/87, there was a policy change to import high analysis fertilizer such as urea (46:0:0) and diammonium phosphate (DAP) instead of CAN, S/A, and other traditional fertilizers. This was done to reduce transport costs per unit of nutrient because DAP and urea are more concentrated than CAN, S/A or other types of traditional fertilizer.

Most of the fertilizer sold to smallholders is applied on hybrid maize (Gladwin 1991). Less is used on tobacco. There are three

varieties of maize grown: local, composite and hybrid. Application of fertilizer on these varieties has been unequally distributed. Although the majority of the land is planted to local maize, only 24.2% of this land was fertilized during 1985/86 crop year.

Responses of local maize, composite maize and hybrid maize to fertilizer are significantly different. Hybrid maize has the highest response (Table 3.4). Hildebrand (1984) found that local maize responds to fertilizer as well as composite maize under farmers' management. It is clear that there is a substantial increase in yields for all maize varieties if fertilizer is applied.

The value marginal product (VMP) of fertilizer for hybrid maize is higher than that of local maize (Gladwin 1991). This implies then that a farmer will apply fertilizer to hybrid maize rather than to local maize. At maximum profit, the ratio of VMP and the price of fertilizer should be equal to one. The pricing system in Malawi favors hybrid maize: in spite of its low demand compared to local maize, hybrid maize is priced the same as local maize.

Since 1983 however, Malawi has been facing continuous foreign exchange problems. To guarantee fertilizer supplies, a five year IFAD/IDA funded Smallholder Fertilizer Revolving Fund (SFRF) was established. Fertilizer use is very important to Malawi due to a number of factors. First, the country faces one of the highest population densities in sub-Saharan Africa (The World Bank 1989b). A feasible way to increase food productivity is to intensify agricultural production through appropriate technology such as fertilizer use. Second, the country's economy is primarily dependent on agriculture for both

employment and foreign exchange earnings (Lele et al. 1988).

Agricultural policy has always favored the estate sector at the expense of the smallholder sector, both in terms of resources and output prices. Smallholders produce the bulk of the food consumed in the country, mainly local maize. Thus, increasing smallholders' productivity should ensure sufficient food for the whole nation. There is need to release the labor tied in food production to other non-agricultural undertakings. This is only possible if agricultural productivity is increased. The pattern of fertilizer use in Malawi at present will not lead to increased agricultural productivity at all. For example, it would be expected that the southern region which has the highest population and less cultivatable land would use more fertilizer than any other region in the country in order to increase agricultural production and productivity. However, this is not the case; instead the central region which has a less population and more cultivable land uses more fertilizer. Although the southern region holds half of the country's population, and 55% of households with less than 1 ha of land, it used only 11% of the country's fertilizer in 1987/88 (Lele et al. 1988). Smallholders in Lilongwe and Kasungu consume more than half of the total fertilizer used by the smallholder sector.

Although the annual rate of increase of sales of fertilizer is higher for smallholders than for the estate sector, it has been reported that some of the fertilizer sold to smallholders leaks to the estate sector (Chirembekreza, personal communication). The fact that outputs for sugarcane, tobacco, and tea increased for the estate sector while those for smallholders either stagnated or decreased, indirectly

supports this assumption. Nathan Associates (1987) estimates this leakage at a level of 25% of the total smallholder fertilizer sales.

Table 3.4 Yields of Maize in Malawi With and Without Fertilizer in Different Land Sizes.

	Fert. ^a per ha (Kg)	Average Yields (Kg)	
		With fert.	Without fert.
<u>< 0.5 ha:</u>			
Local Maize	20	1050	680
Composite Maize	472	2674	1251
Hybrid Maize	544	3259	68
<u>0.5-1.0 ha:</u>			
Local Maize	128	1589	782
Composite Maize	199	2116	890
Hybrid Maize	266	2767	1233
<u>1.0-1.5 ha:</u>			
Local Maize	100	1305	833
Composite Maize	167	2265	1108
Hybrid Maize	221	2655	742
<u>1.5-2.0 ha:</u>			
Local Maize	114	1358	928
Hybrid Maize	100	2048	1525
<u>2.0-2.5 ha:</u>			
Local Maize	102	1403	963
Composite Maize	113	2669	1106
Hybrid Maize	155	3090	850
<u>2.5-3.0 ha:</u>			
Local Maize	104	1251	1097
Composite Maize	165	2244	750
Hybrid Maize	166	2864	1029

^a fertilizer

Source: ASA 1984/85 Worktable 8.1, Zomba, Malawi.

A number of factors have been proposed to explain the causes of these leakages. First, the agricultural policies in Malawi have affected relative returns of fertilizer differently such that, while estates can sell their produce at prices almost equal to those of the world price, the smallholder sector receives only one third to one half of these prices for the same produce (Lele and Agarwal 1989). Second, the sale of fertilizer intended for smallholders is poorly monitored; most of this fertilizer finds its way to the estate sector (Nathan Associates 1987).

Nonetheless, fertilizer consumption for both sectors has increased since 1973 reaching 28,200 metric tons and 18,100 metric tons for the smallholder and estate sector, respectively in 1988 (Table 3.5). Because of this pattern of fertilizer use and sale, together with the slow hybrid adoption, average maize yields have been stagnant in the smallholder sector and more than 70% of the smallholder area is devoted to the production of maize alone. Only 5% of the smallholder area is under hybrid maize. On the other hand, yields per hectare on large estates have tended to be considerably higher than on small farms. This is a result of greater use, per hectare, of fertilizer and other farm inputs that are complementary to fertilizer use. It also reflects the higher value marginal product of fertilizer on exports (Lele and Agarwal 1989).

Pricing Policy and Cropping Patterns

SAPs, as noted above, seek to alter the allocation of resources so that production and productivity of tradables increase by altering the relative prices and the structure of incentives among both tradables and

nontradables. Incentives for the production of tradables under this arrangement are increased at the expense of nontradables. In the case of Malawi, whose economy is dependent on agriculture, such an arrangement targets the agricultural sector. As a result, the SALs, as well as all the policy reform efforts in general, focused on agricultural reform especially for the smallholder sector.

Table 3.5 Fertilizer Use by Smallholders and Estates in Malawi, 1972/73 to 1987/88.

Year	Price ^a	Tons of fertilizer		Smallholder Percentage of Total
		Smallholders	Estates	
1973	-	5602	10,772	34
1974	-	7793	9841	44
1975	-	3561	10,300	25
1976	-	5130	9066	36
1977	-	7030	9279	43
1978	-	10,500	13,600	44
1979	-	11,300	15,700	42
1980	6.1	12,100	15,400	44
1981	11.1	15,800	16,100	50
1982	11.1	13,900	14,700	49
1983	12.2	17,000	15,400	52
1984	12.2	17,800	14,000	56
1985	12.2	21,200	17,000	55
1986	12.2	19,000	17,700	53
1987	16.7	22,200	17,700	56
1988	24.0	28,200	18,100	61

^a price is tambala/kg.

Source: Nathan Associates 1987.

It was expected that, through such reforms, smallholders would change their cropping patterns. Prior to these reforms, smallholders had to sell their produce to ADMARC only at low prices. Under SAP, the proposed policy would raise prices. This price policy would also be beneficial to smallholders if all restrictions regarding crops to grow were dropped. Given that smallholder production is concentrated in local maize, cassava, and other subsistence crops, as well as in cash crops such as cotton, hybrid maize, groundnuts and sun-cured tobacco, the input and producer pricing policy would be an important determinant of cropping pattern and output. This would in turn determine both market levels and household food security. Under such a policy, it was expected that smallholders would switch their resources to the production of crops whose prices had been increased, i.e., high-valued crops, creating crop diversification. A study by Kinsey (1978) showed Malawian farmers responding strongly to these financial incentives. This implies that the above pricing policies can be determinants of cropping patterns. Farmers would prefer high-valued crops and, therefore, maximize scarce resources. Fertilizer use would increase, together with the practice of other agricultural technologies that lead to intensive agriculture. It is unlikely however, that this would happen since, under SAP the prices of these technologies increased. The only alternative is then to extensively use redundant resources such as land. In Malawi, due to high population, this is not expected to happen. In such a situation, therefore, in order to react to increased input and output prices, producers will merely re-allocate land (Sahn et al. 1990). Increasing the relative prices of tradables will encourage

producers to allocate more land and fertilizer to the production of groundnuts, hybrid maize, tobacco, cotton and other tradables and less to the production of nontradables such as local maize, cassava, and sweet potato.

Smallholders and Credit in Malawi

Unlike their counterparts in the estate sector, smallholders cannot borrow money from banks due to their lack of collateral and the high costs involved. Through Agricultural Development Divisions (ADDs) and the NRDP, smallholders are supposed to receive credit through a credit club system. Although the formation of a credit club rests upon the decisions of those who want to join, most smallholders have had little chance to participate because of their financial insecurity. The credit club system requires that no credit is passed to any club that has not cleared all of its preceding loans. If a member defaults, all other members are equally accountable. In order to avoid such a risk, most credit clubs have excluded smallholders whose financial positions have always been weak. Thus, although the number of credit clubs has increased since 1984, the percentage membership of smallholders in these clubs barely exceeded 25% in 1989/90 (Table 3.6). Even if these smallholders were club members, the fear of losing their personal property if they defaulted on a loan, prohibits them from acquiring one.

The Fertilizer Subsidy and Its Removal

Prior to SAP policies, donor agencies used fertilizer subsidies as a means of encouraging rapid fertilizer adoption in the developing world. Subsidies would: a) encourage learning by doing; b) reduce risk fertilizer use; c) help overcome credit constraints; d) help poor

farmers; e) reduce taxation and e) help in soil conservation (Lele et al. 1988).

Table 3.6 Credit Participation and Credit Recovery by Malawian Smallholders.

Year	No. of Credit Clubs	No. of Sh	% Sh ^b	Women as % of Sh	Total Loans (mKw)	% Recovery
89/90	12,000 ^a	300 ^a	25.0 ^a	-	50 ^a	-
88/89	10,849	285	22.2	26.2	41	75
87/88	9129	243	17.9	29.8	27	91
86/87	8045	206	15.2	25.4	18	93
85/86	8259	208	15.3	19.4	19	89
84/85	8148	212	15.6	16.2	16	97
83/84	7191	180	13.2	15.0	11	98
82/83	-	157	11.5	-	8	97
81/82	-	-	-	-	5	98
80/81	-	-	-	-	6	98
79/80	-	-	-	-	4	97
78/79	-	-	-	-	2	98
77/78	-	-	-	-	2	98

^a estimates

^b smallholders

- The blanks indicate unrecovered amounts. In July 1983, 3457 clubs had defaulted K925.

In July 1987, 6602 clubs had defaulted K4,261,400.

Source: Atukorala et al. Table 9, Annex A, 1990.

ADMARC, the state marketing board, has been selling fertilizer to smallholders below cost through a revolving fund with the government meeting the difference. The subsidy was meant to offset the tax imposed on farmers because ADMARC had been buying smallholder produce at prices lower than the world market; it was a form of taxation on smallholders. This is the subsidy which SAP targeted to reduce and eventually remove

through the FSRP. Benefits of this implicit tax on smallholders was passed on to the consumers who purchased maize cheaply from ADMARC, the so called "cheap food policy" (Bates 1989). Such an arrangement benefitted only consumers, many of whom were smallholders and the urban poor, whose real income was expected to increase as a result of this. However, returns to resources such as labor, land and fertilizer for smallholders were depressed. Due to these low returns, particularly to labor, smallholders sought employment on estate farms where wages kept decreasing as the labor supply increased.

The initial Structural Adjustment Loan (SALI) led to an increase in produce prices for smallholders in 1981/82. The smallholder revolving fund was established in 1983 to ensure timely provision of fertilizer to farmers, but, by then, ADMARC faced financial problems (Atukorala et al. 1990). Continued devaluation of the Malawian currency substantially decreased the purchasing power of the fund. SALII, sponsored by the World Bank and Aid for International Development (A.I.D.) in 1984, aimed, among other things, to abolish the entire fertilizer subsidy by 1985/86, starting with a 50% reduction. In 1985 SALIII introduced the Economic Policy Reform Program (EPRP) with two major agricultural objectives 1) to reduce the fertilizer subsidy and eventually eliminate it by 1989/90 and 2) to reduce foreign exchange spent on fertilizer by importing high analysis fertilizer. However, by 1989/90, the fertilizer subsidy had not been substantially reduced as SALIII proposed. Instead, it actually increased to 24% during 1988 from 21% in 1985 (Table 3.7). This only saved 0.6% of the government deficit. It was during 1991 that the subsidy was eventually eliminated.

Table 3.7 Economic Policy Reform Program Budget Savings in Malawi (M Kwacha).

Crop Year	Actual Subsidy	Actual Rate	Assumed Alt. ^b	Ratio of 25 to Actual	Alt. Subsidy	Budget Saving
85/86	6.17	21%	25%	25/21	7.34	1.17
86/87	4.51	18%	25%	25/18	6.26	1.75
	8.89	24%	25%	25/24	9.26	0.37
Total	19.57				22.80	3.29

Note: These savings represent the difference between actual subsidy and the assumed subsidy rate of 25% of 1984/85 before EPRP.

^b Alternative.

Source: Atukolara et al. 1990: Table 13.

The substantial decrease and eventual removal of the subsidy reduced the benefits of transfer payments which smallholders were receiving. An estimated 250,000 households were affected (Atukolara et al. 1990). The second objective, however, was achieved since the country saved an equivalent of K44.6m by 1990 (Table 3.8). This saving, however, has not necessarily become a transfer payment to smallholders.

SALIII also aimed at liberalization of market policies and encouraged crop diversification. It was through this free market that farmers were expected to make rational decisions about fertilizer use depending on its cost and the prices of various crops. However, due to increased transport costs, the Malawian government seemed to back off from the commitment to eliminate the fertilizer subsidy.

The Agricultural Sector Adjustment Credit (ASAC) was concluded under the 1990 program in which smallholders would be allowed, on a limited basis, to grow burley tobacco. Research in the development of an acceptable maize variety was encouraged, and the transfer of land from customary to estate sector was discouraged.

Table 3.8 Savings due to Importation of High Analysis Fertilizer instead of Low Analysis Fertilizer in Malawi.

Crop Year	Savings in M Kwacha	Savings in M Dollars.
1986/87	2529	1,352 ^a
1987/88	7957	33,584 ^b
1988/89	13,068	5065 ^c
1989/90	221,099	7962 ^d
Total	44,653	17,963 ^e

^a K1.87/\$1 ^b K2.22/\$1 ^c K2.58/\$1 ^d K2.65/\$1 ^e K2.65/\$1

Source: Atukolara et al. 1989: Annex A.

So, the justification for the FSRP was that the fertilizer subsidy had caused ADMARC financial problems which were then passed on to the government, since ADMARC was a government parastatal. It was believed that fertilizer subsidy created a distortion such that underpricing fertilizer relative to its true economic cost, would theoretically result in misallocation of resources in its use (Sahn et al. 1990). This could lead, it was argued, to overproduction of fertilizer-intensive crops relative to other crops, beyond the point where marginal returns to production were equal to true marginal costs. Such a policy, coupled with strong extension efforts to promote the production of hybrid maize, may have distorted the production incentives away from more remunerative and less fertilizer-intensive (and hence less costly) cash crops (Sahn et al. 1990). The leakage of subsidized fertilizer, initially meant for smallholders, to estate owners defeated the primary purpose of the subsidy. The subsidy in this case accrues partially to the estate sector in the form of fertilizer priced below the market price. If the intention is to aid smallholders, it is arguable as SAP

does, that a direct cash transfer to them for the value of the entire subsidy by increasing producer prices would be more appropriate.

If the demand for fertilizer is inelastic and fertilizer is a critical input, then demand is not expected to vary substantially with price, given access to credit. Therefore, a decrease in the subsidy level would not result in any sizeable decline in fertilizer intake or loss in production and productivity. Again, it would be logical to argue that a fertilizer subsidy may not induce substantial increases in application in the smallholder sector given the different tastes, preferences, and quality differences between crops. These may affect production decisions more than yield criteria alone. This is shown with hybrid maize whose yield, even though higher than the local variety, is less preferred to the local variety due to taste, labor requirements, spillage during food preparation, resistance to pests, and length of shelf-life under rural conditions. In such a situation, if shortage of labor is a constraint on food preparation, it can be a factor as well in the determination of cropping patterns. Preferences on these accounts would imply a lower responsiveness of agricultural production to a fertilizer subsidy, which means therefore that less quantity of fertilizer is demanded with the removal of the subsidy.

It is argued that because small farms use limited amounts of fertilizer, removing the subsidy will, therefore, have only a marginal effect on their production. Furthermore, since smallholder fertilizer inputs are quantity constrained by a combination of the subsidy rate and the budget allocation on the subsidy, access to fertilizer can be broadened if the fertilizer subsidy scheme is suspended.

On the other hand, an argument against the FSRP since the program was put into play, is that none of its objectives have been met. Due to the increase in the freight costs of importing fertilizer, and the devaluation of the Malawian kwacha in 1988 (at 82% of its 1984 value), the FSRP has been placed in jeopardy. Another objective of the FSRP was to encourage farmers to adopt High Analysis Fertilizers (HAF) instead of the Low Analysis Fertilizers (LAF) that were in use prior to the SAP. However, because the subsidy on sulphate of ammonia, a low analysis fertilizer, was increased through 1986/87, the objective for HAF adoption was barely met (Sahn et al. 1990).

Because fertilizer is such an important input factor in agricultural production, its demand would be expected to be inelastic. However, on the contrary, fertilizer use in the smallholder sector has been increasing with price increases. By looking at the ratio of fertilizer to maize prices, Sahn et al. (1990) observed how this index fell between 1978/79 and 1981/82 and then steadily rose until 1986/87. Christiansen and Southworth (1988) used the value cost ratio (VCR) as a more appropriate way to explain the incentive structure faced by the farmers. The value cost ratio (VCR) is defined as the incremental output per kilogram of nutrient divided by the value of incremental cost per kilogram of nutrient (Sahn et al. 1990). The VCR for local maize has steadily declined from 3.28 in 1981/82 to 1.71 in 1986/87. It rose marginally in 1987/88 and 1988/89 as a result of maize price increases in those years. As such, the increase in maize prices has not compensated for the increasing nutrient prices and does not, therefore, encourage farmers to invest in fertilizer. Thus, the increase in

fertilizer use with price increases, as observed, is a reflection of rationing fertilizer as the demand exceeds the supply available to the smallholder sector at a subsidized price. However, the rent associated with the rationing of fertilizer accrues not to the smallholder sector but to the large farmers in the customary lands who have better access to credit and are the ones responsible for the fertilizer uptake. Relaxing supply constraints benefits these farmers rather than smallholders. Sahn et al. (1990) doubt whether smallholders, who face seasonal cash constraints and inaccessibility to credit, really benefitted from the increases in fertilizer uptake.

The higher fertilizer utilization rates, despite the decrease in the maize-fertilizer VCRs, can be explained by the increased application of fertilizer by smallholders to cash crops. As the subsidy was reduced and fertilizer prices raised, there were diminishing gross margins on local maize sales. As a result, smallholders had no incentive to increase their local maize production. The increase in the hectareage of cash crops points to the increase in fertilizer uptake for these crops, and possibly decreased fertilizer use in food crop production. The FSRP would have important food security implications in the short run; yet, the fact that local maize productivity has stagnated over this period, suggests the need for closer examination of this issue.

Two sets of questions arise here. First, the question policy makers asked in 1987 before the subsidy removal was: How would farmers react to an increase of 50%-100% in the price of fertilizer with the removal of the fertilizer subsidy? Second, at present when the subsidy is completely (or soon expected to be) eliminated, the questions asked

are related to the trend of producer prices during reforms and how the pricing policy has affected smallholder production. If there has been no effect, then why hasn't there been?

CHAPTER 4 METHODS AND METHODOLOGY

This study does not intend to seek a total evaluation of the structural adjustment program in Malawi; rather it aims to show the implications of the structural adjustment program's goals to withdraw the fertilizer subsidy from Malawi's smallholders. Studies have shown that maize and other crops are fertilizer responsive and any change which results in decreased fertilizer use will lead to reduced agricultural output (FAO 1984). It is argued if no fertilizer subsidy is available, smallholders will use little to no fertilizer because it is too expensive when unsubsidized. The removal of the fertilizer subsidy will work against an expansion of local maize production, an expansion made necessary by an increasing population growth rate, an influx of refugees from Mozambique into Malawi, and the first signs of lack of food self-sufficiency in Malawi threatening food security throughout the country. If this occurs, there will then be the need to import maize from elsewhere, and the import costs will be much greater than the cost of subsidizing fertilizer.³

After providing a general description of the SAPs in sub-Saharan Africa, and particularly in Malawi, and more especially SAP policy toward fertilizer subsidies in Malawi, there is a need to analyze the

³The civil war in Mozambique has cut the Beira railway line that links Malawi to the port of Beira in Mozambique. Consequently, Malawi has had to resort to the South African port of Durban for imports and exports at significantly greater costs.

economics of the Fertilizer Subsidy Removal Program in Malawi and evaluate its impacts on smallholders. To achieve this, the main factors limiting smallholders' use of chemical fertilizer are determined using three statistical methods: ordinary least squares, probit and tobit analyses. These methods will be used to determine the factors limiting the use of chemical fertilizer in Malawi, and also determine whether smallholders who are credit club members use more fertilizer than nonclub members. In addition, the probability that a smallholder will use chemical fertilizer is estimated. These methods are described below.

Finally, supply elasticities and profitabilities, based on aggregate data from the Ministry of Agriculture, Malawi, will be calculated to test the hypothesis that an increase in the price and profitability of local maize does not elicit a positive supply response in local maize production, but does elicit an increased supply response in hybrid maize production. This will show whether or not smallholder farmers, during structural adjustment, intend to increase production of tradables rather than nontradables. The same method will be used to show whether or not the sexual division of labor in Malawi is a barrier to the re-allocation of labor from nontradables to tradables. If so, the fertilizer subsidy removal program is not gender-neutral but rather gender-biased.

Data

Two sets of data are to be used in our analysis. The first set of data were collected by the Ministry of Agriculture of Malawi, during the cropping periods 1985/86 and 1986/87, in three Agricultural Development

Divisions (ADDs), namely Kasungu, Lilongwe, and Blantyre, before the fertilizer subsidy was removed. These data consist of 196, 185, and 145 individual observations of smallholder fertilizer use and cropping patterns respectively. Such variables as size of land holdings, hectarage planted to various crops, gender of household heads, credit-club membership, frequency and amount of chemical fertilizer and/or manure used, and availability of cash to farmers are included. The dependent variable is the amount of fertilizer a smallholder uses. This variable is dependent on size of landholding, club membership, gender, cash availability, presence of manure use, and type of crop grown, i.e., cash or food crops. These data will be used in the method of ordinary least squares, probit, and tobit analyses to determine the factors affecting smallholders' use of fertilizer.

The second set of data, aggregate data, were also collected by the Ministry of Agriculture of Malawi from all over the country during the period 1982 to 1990 before and after the fertilizer subsidy was removed. These data will be used to determine the supply response of smallholders to producer prices, as well as test the hypothesis of gender-bias in labor- and land re-allocation during the removal of the fertilizer subsidy. These two sets of data allow us to evaluate the success or failure of the fertilizer subsidy removal program and its implications for food security in Malawi. A look at the theories behind the models used in analyses of both data sets is appropriate.

The Ordinary Least Squares Method

Ordinary least squares is a method most often used by social scientists to do multiple regression analysis. Its aim is to "fit" a

line to a set of points or observations by minimizing the sum of the squares of the error terms (Gujarat 1989). In the case of Malawi smallholders' use of fertilizer, the estimated variable Y_i is the quantity of fertilizer used, which is determined by a number of independent variables. Gladwin (1989a, 1989b), using a decision tree model to elicit the decision model Malawi smallholders use in deciding between chemical and organic fertilizers, indicated a number of determining factors. These include: area of land held by a smallholder, membership in a credit club, availability of cash and/or credit, gender, level of manure use in a cropping season, and type of crop. These factors influence behavioral decisions of a smallholder to determine whether or not a man or a woman uses fertilizer, and if so, in what amounts. These decision models have been successful in predicting the historical choices of farmers to use chemical fertilizer; because of their predictability, the variables in these models have been used as independent variables in the equations below. Thus, the present study uses these variables to estimate the equation

$$(4.1) \quad Y_i = \beta_0 + \beta_1 \text{area}_i + \beta_2 \text{nocash}_i + \beta_3 \text{club}_i + \beta_4 \text{gender}_i + \beta_5 \text{cmanure}_i + e_i$$

where Y_i , the amount of fertilizer in kilograms, is the dependent variable. The independent variables are: area in hectares, "nocash," a dummy variable that represents the inability of smallholders to acquire fertilizer due to lack of cash or credit, "club," a dummy variable representing whether or not a smallholder is a credit club member, "cmanure," is a dummy variable to represent whether or not the

smallholder currently applies manure, and "gender," is a dummy variable representing whether a smallholder is male or female.

In addition to these factors, the type of crop grown by a smallholder also will determine the level of fertilizer use. Thus,

$$(4.2) \quad Y_i = \beta_0 + \beta_1 \text{area}_i + \beta_2 \text{nocash}_i + \beta_3 \text{club}_i + \beta_4 \text{gender}_i + \beta_5 \text{cmanure}_i + \beta_6 D1 + e_i$$

where D1 is a dummy which represents local maize. In equation 4.3, D2 a dummy for hybrid maize, is included.

$$(4.3) \quad Y_i = \beta_0 + \beta_1 \text{area}_i + \beta_2 \text{nocash}_i + \beta_3 \text{club}_i + \beta_4 \text{gender}_i + \beta_5 \text{cmanure}_i + \beta_7 D2 + e_i$$

In equation 4.4, other crops are included as defined below.

$$(4.4) \quad Y_i = \beta_0 + \beta_1 \text{area}_i + \beta_2 \text{nocash}_i + \beta_3 \text{club}_i + \beta_4 \text{gender}_i + \beta_5 \text{cmanure}_i + \beta_6 D1 + \beta_7 D2 + \beta_8 D3 + \beta_9 D4 + \beta_{10} D5 + \beta_{11} D7 + e_i$$

where D3 is the dummy variable for composite maize, D4 is the dummy variable for rice, D5 is the dummy for groundnuts, and D7 is the dummy for tobacco. These are demand equations although the price of fertilizer, which is usually a very important demand factor, is not included because in Malawi, the price is fixed and only changed by the Malawi Government.

Statistical Models of Qualitative Choice

The Probit Model

Probit is one of the statistical models of qualitative choices which assumes that when individuals are faced with a choice between two discrete alternatives, their choice depends on the individuals' socio-

economic characteristics (Pindyck and Rubinfeld 1981).⁴ For example, the prediction of smallholders' adoption and use of fertilizer would depend on a number of factors, e.g., their income, farm size, etc. A smallholder with a higher income, with other factors constant, has a higher probability of adoption and use of fertilizer than his/her counterpart with a smaller income. Another characteristic that can influence the smallholder's adoption of fertilizer is the amount of land owned. A smallholder with more land has a higher probability of applying fertilizer than one with less land.

The purpose of a qualitative choice model such as probit is to help determine the probability that an individual, with a given set of attributes, will make one choice (apply fertilizer, i.e., $Y = 1$) rather than the alternative (not apply fertilizer, i.e., $Y = 0$). In this way it is possible to find a relationship between a set of attributes describing an individual and the probability that the individual will make a given choice. A linear function is assumed when determining this relationship. In the probit model, the (0,1) values of the dependent variable are transformed such that the predicted values of Y i.e., $\hat{Y}$, have continuous values on the interval from 0 to 1. In this way, it is possible to translate the (0,1) values of the dependent variable to a probability which continually ranges from 0 to 1. This transformation also means that increases in the independent variables X_i lead to increases in the dependent variable Y_i . Using the cumulative probability function, we obtain the probability distribution represented by equation 4.5.

⁴This section uses Pindyck and Rubinfeld 1981 Chapter 10.

$$(4.5) \quad P_i = (\beta_0 + \beta_1 X_i + \epsilon_i) = F(Y_i)$$

Under the assumption that the model is transformed using a cumulative uniform probability function, the constrained version of the linear probability model $P_i = \beta_0 + \beta_1 X_i + \epsilon_i$ is derived. The probit probability model is associated with the cumulative normal probability function.⁵ To understand this model, assume there exists a theoretical continuous index Y_i which is determined by an explanatory variable X_i . Therefore, it can be written as

$$(4.6) \quad Y_i = \alpha + \beta X_i + \epsilon_i.$$

The data are such that Y_i is not a continuous quantitative variable; it is discrete. Generally, the data available can be distinguished only on the basis of whether individual observations are in one category (high values of Y_i) or in a second category (low values of Y_i). Probit analysis solves the problem of how to obtain estimates for the parameters β_0 and β_1 while at the same time obtaining information about the underlying index Y (Pindyck and Rubinfeld 1981: 254).

If fertilizer application by smallholders is presented by a dummy variable, then $Y = 1$ if a smallholder applies fertilizer and $Y = 0$ if he/she doesn't. If Y_i^* is the critical cutoff value that translates the underlying index into a decision to apply fertilizer, then smallholders

⁵A cumulative probability function is defined as having as its value the probability that an observed value of a variable X (for every X) will be less than or equal to a particular X . The range of the cumulative probability function is the $(0,1)$ interval, since all probabilities lie between 0 and 1.

apply fertilizer if $Y_i > Y_i^*$, and they do not apply fertilizer if $Y_i \leq Y_i^*$.

Therefore, it is possible using the Probit model to estimate the conditional probability that a smallholder applies fertilizer given some facts beforehand such as the amount of land he/she possesses, his or her income, type of crop he/she grows and membership in a credit club. The limitation of this model is that it ignores any effect of zero observations. Also, it does not show differences in the amount of fertilizer used, because as long as a smallholder uses some fertilizer, he/she is given a value of one. The equation to be estimated is

$$(4.7) \quad P_i(0,1) = \beta_0 + \beta_1 \text{area}_i + \beta_2 \text{nocash}_i + \beta_3 \text{club}_i + \beta_4 \text{gender}_i + \beta_5 \text{cmanure}_i + e_i$$

where P_i is the probability.

It is expected that the probability of a smallholder to use of fertilizer will be determined by the independent variables: area, nocash, club, gender, and cmanure. Using this equation, the probability that he/she will apply some fertilizer on a given crop will be determined. Dummies representing each of the crops are included in the equation to determine whether they affect the farmer's choice to use fertilizer. For local maize, the dummy D1 is used during estimation i.e.,

$$(4.8) \quad P_i(0,1) = \beta_0 + \beta_1 \text{area}_i + \beta_2 \text{nocash}_i + \beta_3 \text{club}_i + \beta_4 \text{gender}_i + \beta_5 \text{cmanure}_i + \beta_6 D1 + e_i$$

In equation (4.9), D2 the dummy representing hybrid maize, is included.

$$(4.9) \quad P_i(0,1) = \beta_0 + \beta_1 \text{area}_i + \beta_2 \text{nocash}_i + \beta_3 \text{club}_i + \beta_4 \text{gender}_i \\ + \beta_5 \text{cmanure}_i + \beta_6 D2 + e_i$$

Equation (4.10) includes all variables.

$$(4.10) \quad P_i(0,1) = \beta_0 + \beta_1 \text{area}_i + \beta_2 \text{nocash}_i + \beta_3 \text{club}_i + \beta_4 \text{gender}_i \\ + \beta_5 \text{cmanure}_i + \beta_6 D1 + \beta_7 D2 + \beta_8 D3 + \beta_9 D4 + \beta_{10} D5 + \beta_{11} D7 + e_i$$

The Tobit Model

In contrast to Probit, Tobit analysis is useful in a situation where the dependent variable is continuous but there are a number of observations with values of 0. It is useful in this case of smallholders' use of fertilizer, because almost 55% of the sample applied no fertilizer at all, while 45% applied some, so that $Y_i > 0$. For the latter, fertilizer use was a quantitative variable. In such a situation, the dependent variable is said to be truncated and thus ordinary least-squares estimation will generate biased and inconsistent parameter estimates. Tobit analysis, therefore, provides a better alternative. For example, if the continuous model is given by

$$(4.11) \quad Y_i^* = \beta_0 + \beta_1 X_i^* + e_i^*$$

where Y_i^* represents the amount of fertilizer applied for those using fertilizer, then for smallholders who do not apply fertilizer, Y_i^* is zero. This then gives the observed dependent variable:

$$(4.12) \quad Y_i^* = \beta_0 + \beta_1 X_i^* + \epsilon_i^*$$

$$(4.13) \quad Y = Y_i^* \text{ for } Y_i^* > 0$$

$$(4.14) \quad Y = 0 \text{ for } Y_i^* \leq 0$$

The actual estimated equation will then appear as:

$$(4.15) \quad Y_i = \beta_0 + \beta_1 X_i + \epsilon_i$$

Y_i , the dependent variable, is the amount of fertilizer, X_i are the independent variables, i.e., area, nocash, club, gender, cmanure, D1, D2, D3, D4, D5, and D7.

Supply Response

In developing countries like Malawi, the term "Supply Response" refers to the change in agricultural output and hectarage due to variation in price (Ghatak and Ingersent 1984). The volume of a smallholder's output depends on the price of the previous season or year, the present hectarage under cultivation, weather conditions in the present year (including amount and intensity of rainfall, sunshine), and a catch-all variable which is not specifically known. Output is expected to vary positively with price in the previous season, or year, i.e.,

$$(4.16) \quad \frac{\delta Q_s}{\delta P_{t-1}} > 0.$$

Hectarage under cultivation is taken as a proxy for output due to a very close relationship between hectarage and output. Supply response,

therefore, has been assumed to be equivalent to the response of hectarage to changes in economic and non-economic factors.

The supply response of hectarage to changes in prices is usually upward sloping, implying that the smallholders in developing countries behave rationally. Hence, it is expected that the higher the price, the greater the hectarage. If it is assumed that Ha_t represents the quantity of output and taken as the supply response, then a normal supply curve occurs when the elasticity of supply η_s is greater than one (Ghatak and Ingersent 1984). Therefore,

$$(4.17) \quad \eta_s = \frac{\delta Ha / Ha_t}{\delta P / P_t} > 0,$$

where δHa denotes the change in hectarage given by the difference between the present hectarage and the previous hectarage, δP as the change in price given by the difference between the present year and previous year price levels. If the elasticity of supply is less than one but greater than zero, i.e.,

$$(4.18) \quad 0 < \eta_s < 1,$$

then there is an inelastic supply response to prices. If on the other hand,

$$\eta_s = 0,$$

then the supply of output has not responded to price changes. If the supply elasticity is negative, a situation of "perverse supply" response, then the farmers have produced less despite the rise in price.

CHAPTER 5

THREE SETS OF RESULTS

In this chapter, the results of estimating equations 4.1 to 4.4, and equations 4.7 to 4.10 are presented, using the three methods of Ordinary Least Squares, Probit, and Tobit analyses. Before these results are presented, however, it is useful to examine some descriptive statistics from the data set used to estimate these equations. The 1987 Rapid Fertilizer Survey (RFS) is referred to data collected by Malawi's Ministry of Agriculture from 526 farmers in the districts of Lilongwe, Kasungu, and Blantyre. Some needed insight into land and capital distribution, fertilizer use, and cropping patterns common in Malawi in 1986/87 are given by these statistics, before the structural adjustment program and the fertilizer subsidy removal program substantially reduced or removed the fertilizer subsidy and increased the price of chemical fertilizer. After these results (called "results 1") are presented, the results (called "results 2") of estimating the equations described in Chapter 4 are given.

Following both "results 1" and "results 2" are the third set of results ("results 3") that describe the aggregate supply response, or lack thereof, of Malawi's farmers to the removal of the fertilizer subsidy in 1987/88. This third set of results, to be presented at the end of this chapter, will show that farmers' supply response to Malawi's fertilizer subsidy removal program is a "mixed bag" of results depending

on both the gendered division of labor and traditional cropping patterns. In order to understand the latter, a look at some descriptive statistics is instructive.

Results 1: Some Descriptive Statistics

Agricultural production is affected by the quantity of factors of production that a smallholder has access to. The distribution of these factors of production e.g., land, capital, among smallholders is an important determinant of their level of fertilizer use. Therefore, by looking at these distributions, it is possible to determine the factors which limit fertilizer use. Land distribution is the most important of these. More than 50% of the households possess not more than 1.5 hectares (Table 5.1). Of these, 152 households have between 0.5 and 1 hectare while only 24 households have holdings of 3 hectares or more. In a situation where technology is inadequate, land is a limiting factor of production and, given that in Malawi the household family is the major source of labor, the distribution of land is an important factor in the ability of farmers to respond to new production frontiers. As seen from the results, this ability is greatly impaired since less land means less crops and vice versa. About 33% of the sample includes female-headed households, a proportion in line with Due's findings on female-headed households in Africa (Due 1991). Of the category of female-headed households, 80% possess less than 1 hectare. The category of the landless is entirely composed of females. Therefore, there is skewness in land distribution as well as in land distribution by gender. The fact that women produce most of the food consumed in the family and, are as yet unfavored in land distribution raises the question of food

security in Malawi. It is also true that men grow cash crops rather than food crops which raises a gender-related issue in the distribution of factors of production especially land and its impact on household food security.

Table 5.1 Distribution of Land Size by Gender in Malawi.

Size (ha)	no land	0.5	0.5-1	1-1.5	1.5-2	2-3	3-4	4-5	5+
Female (n=172)	11	51	69	25	10	5	1	0	0
% Female	100	43.2	45.4	23.6	15.6	9.8	6.7	0	0
Dist. ^a of Female	6.4	29.7	40.1	14.5	5.8	2.9	0.6	0	0
Male (n=354)	0	67	83	81	54	46	14	4	5
% Male	0.0	56.8	54.6	76.4	84.4	90.2	93.3	100	100
Dist.of Male	0.0	18.9	23.5	22.9	15.3	13.0	4.0	1.1	1.4

^a distribution of females in this category as percent of total females.
Source: Rapid Fertilizer Survey 1986/87.

The ability of a smallholder to acquire fertilizer is determined in part by his or her financial position. He or she can buy fertilizer on cash or credit. In a situation where a smallholder has insufficient funds, or is unable to acquire fertilizer on credit, he/she will not use fertilizer. Therefore, access to cash and/or credit determine whether or not farmers use fertilizer; it is represented in our model by the variable Nocash. If Nocash=1, farmers did not have cash or capital to buy fertilizer. They responded that: 1) they had insufficient money; or 2) fertilizer was expensive; or 3) they could not get credit to buy fertilizer. The distribution of smallholders' ability, in different land sizes, to purchase fertilizer on cash or credit is demonstrated in

Table 5.2. Slightly over 50% of all farmers could not pay cash or get fertilizer on credit, while the remainder indicated a capability to do so. The willingness to pay cash for fertilizer generally increased with land size, an indication that farmers with more land had more capital than those with less land. Since farmers with more land are able to diversify and, therefore, can grow the high-valued crops (tradables), they are able to raise their incomes.

Table 5.2 Distribution of "Nocash" by Different Land Sizes in Malawi.

Land Size (ha)	no land	0.5	0.5-1	1-1.5	1.5-2	2-3	3-4	4-5	5+
"Nocash=0" (n=246)	5	22	67	46	43	43	12	4	4
As % of Nocash=0 ^a	2.0	8.9	27.3	18.7	17.5	17.5	4.9	1.6	1.6
Nocash=1 (n=280)	6	96	85	60	21	8	3	0	1
As % of Nocash=1	2.1	34.3	30.4	21.4	7.5	2.9	1.1	0.0	0.4

^a distribution of farmers in this category as a percent of total who said NOCASH=0, i.e., they had cash.

Source: Rapid Fertilizer Survey 1986/87.

The bulk of the financially weak, that is, those farmers who cannot pay cash for fertilizer, mainly fall in the landholdings categories of those with not more than 1.5 hectares. This is because economic returns from the land are low which in turn lead to low incomes. Their economic returns are low because of their inability to diversify into high-valued crop production due to land limitations.

The ability of farmers to acquire fertilizer on credit is in part determined by their membership in credit clubs. In this sample of 526

farmers, there are more nonclub members than club members: 396 vs 192.

This is summarized in Table 5.3.

Table 5.3 Credit Club Membership by Gender in Malawi.

	Gender (N=526)	
	Female (n=172)	Male (n=354)
Club Members	18	112
% of Club Members	13.9	86.2
% Of Gender	10.5	31.6
NonClub Members	154	242
% of NonClub Members	38.9	61.1
% of Gender	89.5	68.4

Source: Rapid Fertilizer Survey 1986/87.

Of the female sample, only about 14% claim membership in credit clubs. The males, on the other hand, are distributed almost equally between club and nonclub membership. It is assumed that membership in a credit club is automatic for a woman as long as her husband is already a member. This, however, does not mean women can acquire credit. Although credit is given to both husband and wife, the husband takes control of it and applies it to his crops and little is left for a woman's crops (Gladwin 1991).

The distribution of fertilizer application by farmers of different land sizes also reveals useful information. Among smallholders with 0.5 hectare of land, 101 out of 118 do not apply fertilizer. This represents about 85% of smallholders in this category of land sizes (Table 5.4). For those with landholdings of more than 0.5 hectare up to

1 hectare, the percentage decreases to 58%; that is, of 152 smallholders in this land category, 89 do not use fertilizer. This is about the same percentage as for those with landholdings between 1 and 1.5 hectares. Generally, as the size of land increases, the number of smallholders who apply fertilizer increases. As such, 41 out of 61 smallholders with land size between 1.5 and 2.0 hectares apply fertilizer, while 40 out of 51 smallholders with 2 to 3 hectares apply fertilizer. Clearly, fertilizer use among farmers in Malawi is very low and varies with farm size.

Manure can either be a complement of or a substitute for fertilizer (Table 5.5). Farmers are distributed equally between those who apply manure (n=264) and those who do not (n=262).

Table 5.4 Land Sizes and Fertilizer Use in Malawi.

Size (ha)	no ^b land	0.5	0.5-1	1-1.5	1.5-2	2-3	3-4	4-5	5 +	N
No. farmers	11	118	152	106	64	51	15	4	4	526
Don't apply fert. ^a	9	101	89	64	23	11	2	0	0	301
Apply fert.	2	17	63	42	41	40	13	4	4	225

^a fertilizer

^b land caretakers

Source: Rapid Fertilizer Survey 1987.

Of those who apply manure, 83% are nonclub members, an indication that manure might serve as a substitute for chemical fertilizer. In fact, 85 club members do not apply manure at all. However, results of ordinary least squares analysis and the tobit model will show a strong

Table 5.5 Distribution of Smallholders in Malawi
by Club Membership and Manure Use.

	Category	
	Apply Manure (Total=264)	Do not Apply (Total=262)
Club Members	45	85
% Club Members	34.6	65.4
% of Category	17.1	32.4
NonClub Members	219	177
% NonClub Members	55.3	44.7
% of Category	83.0	67.6

Source: Rapid Fertilizer Survey 1986/87.

complementary (positive) relationship between chemical fertilizer application and manure use.

Cropping Systems and Fertilizer Use in Malawi

The crops grown in Malawi include three varieties of maize: local maize, composite maize, and hybrid maize. Other crops such as cotton, groundnut, tobacco, pulses, cassava, sugarcane, rice and sweet potato are also grown. More than 93% of households in all districts grew local maize for both crop years, 1985/86 and 1986/87. The mean area planted in local maize was constant for both years and was less than 1 hectare. However, individual values differed across districts, with Kasungu having the highest mean hectarage of 0.88 hectare. When all data are combined, the mean area is 0.75 hectare. Such an arrangement is typical of smallholders who normally give priority to food crops. Because the majority possess less than 1 hectare of land, most of their land is under local maize cultivation (Table 5.6).

Hybrid maize is grown throughout the districts. The mean area of hybrid varies among districts, with Blantyre having the lowest for both years and Kasungu the highest. Generally for all districts, the mean area for 1986/87 is slightly lower than that of the previous year. The number of smallholders growing hybrid maize is very small, with the percentage increasing slightly from 6% of all households in 1985/86 to 8% in 1986/87. Fewer (4%) of smallholders grow composite maize. There was no composite maize grown in Blantyre in 1985/86. The mean hectareage for composite maize is 1.0 hectare. Cotton is rarely grown by smallholders in both years, with a few farmers "picking it" in Lilongwe to give a mean hectareage of 0.8 hectare. Tobacco was grown in all districts except Blantyre in 1986/87. The mean hectareage for tobacco shrinks from 0.8 hectare in 1985/86 to 0.4 hectare in 1986/87. Groundnuts is a favorable crop grown in all districts. However, in all 3 districts, the mean hectareage of 1986/87 is less than that of 1985/86. The number of smallholders growing groundnuts likewise decreases in all districts. For example, in Kasungu the mean hectareage decreases from 1.0 hectare in 1985/86 to 0.6 hectare in 1986/87. The number of smallholders growing groundnuts in the same district decreases slightly to 138 from 150. Cassava was grown on a small scale in all districts, together with other crops such as sweet potato, rice, and sugarcane dispersed among districts. The quantity of fertilizer per hectare applied greatly varied between crops (Table 5.7). During 1986/87, hybrid maize received the highest quantity of fertilizer, followed by tobacco, cotton, composite maize, and then local maize. Small quantities were applied on rice, cassava, groundnuts, and sweet potato.

Table 5.6 Mean Area (ha) Of Common Crops in 1986/87 and 1985/86 in Lilongwe, Blantyre, and Kasungu.

Crop:	Lilongwe		Blantyre		Kasungu		Malawi	
	1986/ 87	1985/ 86	1986/ 87	1985/ 86	1986/ 87	1985/ 86	1986/ 87	1985/ 86
LM (n)	0.8 ³ (123)	0.8 (123)	0.6 (184)	0.6 (184)	0.9 (174)	0.9 (174)	0.8 (481)	0.8 (481)
CM (n)	1.1 (3)	1.0 (5)	0.0	0.7 (1)	0.8 (8)	1.0 (9)	0.9 (11)	1.0 (15)
HM (n)	0.4 (10)	0.6 (16)	0.2 (2)	0.4 (4)	0.8 (16)	0.9 (39)	0.6 (28)	0.8 (59)
TB (n)	0.4 (28)	0.8 (31)	0.0	0.1 (1)	0.4 (45)	0.8 (63)	0.4 (73)	0.8 (95)
GN (n)	0.4 (80)	0.7 (86)	0.3 (47)	0.4 (51)	0.6 (138)	1.0 (150)	0.5 (266)	0.8 (287)
CT (n)	0.8 (2)	0.0 (2)	0.0	0.0	0.0	0.0	0.8 (2)	0.0 (2)
CS (n)	0.2 (2)	0.4 (2)	0.3 (19)	0.2 (19)	0.2 (10)	0.2 (10)	0.2 (31)	0.2 (31)
SC (n)	0.0	0.0	0.0	0.0	0.1 (2)	0.0	0.1 (2)	0.0
RC (n)	0.0	0.0	0.2 (7)	0.2 (7)	0.0 (1)	0.0 (1)	0.0 (8)	0.1 (8)
SP (n)	0.1 (19)	0.0 (21)	0.1 (3)	0.1 (10)	0.1 (15)	0.1 (8)	0.1 (37)	0.1 (39)

LM - Local maize, CM - Composite maize, HM- Hybrid maize, GN - Groundnuts, CT - Cotton, RC - Rice, SP - Sweet potato, CS - Cassava, SC - Sugarcane TB - Tobacco.

³ Area is approximated to one decimal place, hence an area such as 0.02 or 0.04 is taken to be 0.0 hectare. This is the reason why there are farmers even if area is 0.0 hectare.

Source: Rapid Fertilizer Survey 1986/87.

The limited observations on cotton make its mean value appear rather large. The same trend of fertilizer use is observed for 1985/86 except that no fertilizer is applied on cotton, sweet potato and sugarcane. Differences in the quantity of fertilizer per hectare for a

given crop are indicated across districts. In 1985/86, Lilongwe applied more fertilizer on hybrid maize at a rate of 284 kg/ha followed by Kasungu at 240.1 kg/ha. Blantyre applied only 95.4 kg/ha. In the same year, Kasungu had 121 kg/ha on composite maize, Blantyre 75.8 kg/ha, while Lilongwe did not apply any fertilizer. The amount of fertilizer on tobacco and local maize is highest in Kasungu and least in Blantyre. No fertilizer was applied on sweet potato, cotton, and sugarcane. Only Blantyre applied some fertilizer on rice. The trend in fertilizer use changes in 1986/87. Lilongwe applied the highest amount of fertilizer on hybrid maize, again followed by Kasungu, and Blantyre applied none. Lilongwe has the highest amount (192.3 kg/ha) for tobacco, followed by Kasungu at 177.5 kg/ha. No fertilizer was applied on tobacco in Blantyre. Only Lilongwe applied some fertilizer on cotton. There was a substantial amount of fertilizer applied on sweet potato (about 250 kg/ha) in Blantyre followed by Kasungu; Blantyre did not apply any fertilizer on cotton. More fertilizer was applied on groundnuts in Blantyre than any other district, and it was only in Blantyre that a few farmers applied some fertilizer on rice. Again no district applied fertilizer on sugarcane in 1986/87. During 1985/86 and 1986/87, there are differences in the quantity of fertilizer applied on a particular crop. The average amount of fertilizer on composite maize was higher in 1986/87, at about 134 kg/ha, than that of the previous year at 76 kg/ha. There was a decrease from 238 kg/ha of fertilizer applied on hybrid maize in 1985/86 to 223 kg/ha in 1986/87. Tobacco received more fertilizer in 1986/87 than in 1985/86. Other smaller increments can also be observed for cotton, sweet potato and groundnuts. However, the

Table 5.7 Average Amount of Fertilizer Applied per Hectare
on Common Crops in Malawi in 1986/87 and 1985/86.

	Lilongwe		Blantyre		Kasungu		Malawi	
	1986 /87	1985 /86	1986 /87	1985 /86	1986 /87	1985 /86	1986 /87	1985 /86
LM (n)	69.5 (123)	50.8 (123)	32.9 (184)	18.8 (184)	41.2 (172)	67.8 (172)	47.0 (479)	44.6 (479)
CM (n)	83.5 (3)	0.0 (0)	83.5 (3)	0.0 (3)	152.8 (8)	121.0 (5)	133.9 (11)	75.7 (9)
HM (n)	278.8 (10)	284.0 (8)	0.0 (2)	95.4 (3)	216.6 (16)	240.1 (27)	223.3 (28)	238.1 (38)
TB (n)	192.3 (28)	106.2 (20)	0.0 (0)	0.0 (1)	177.5 (45)	124.5 (48)	186.6 (73)	117.4 (69)
GN (n)	36.4 (80)	20.8 (47)	47.1 (47)	42.3 (27)	8.9 (138)	8.1 (80)	24.0 (265)	18.0 (174)
CT (n)	164.0 (2)	0.0 (0)	0.0 (0)	0.0 (1)	0.0 (0)	0.0 (1)	164 (2)	0.0 (2)
CS (n)	0.0 (2)	0.0 (2)	2.7 (19)	26.0 (12)	72.2 (10)	23.5 (5)	25.0 (31)	22.6 (19)
SC (n)	0.0 (0)	0.0 (0)	0.0	0.0	0.0	0.0	0.0	0.0
RC (n)	0.0 (0)	0.0 (0)	23.8 (7)	47.7 (7)	67.8 (1)	0.0 (1)	44.7 (8)	41.8 (8)
SP (n)	131.6 (19)	0.0 (6)	250.0 (3)	0.0 (10)	0.0 (15)	0.0 (7)	87.8 (37)	0.0 (23)

Note: kg/ha of planted crop approx. to one decimal point. Because 0 kg/ha is taken as an observation, (n) does not necessarily mean all farmers applied fertilizer.

LC - Local maize, CM - Composite maize, HM - Hybrid maize, TB - Tobacco, RC - Rice, SP - Sweet potato, GN - Groundnuts, CT - Cotton.

Source: Rapid Fertilizer Survey 1986/87.

amount of fertilizer per hectare applied on local maize is almost the same in both years.

Across the districts, there is also much variation in fertilizer application during these two years. While there is an increment of about 40% in the amount of fertilizer applied on local maize in Lilongwe from 1985/86 to 1986/87, that is, from 51 kg/ha to 70 kg/ha, and an increment of over 50% in Blantyre in the same period, Kasungu registers a decrease of about 40%. Generally, most fertilizer is used in Kasungu for both years. Smallholders in Blantyre applied the least amount of fertilizer.

There are various explanations for these observations. Blantyre applied the least amounts of fertilizer due to the high population in the district. Although it is expected that a high population would induce more fertilizer use, the fact that land is more fragmented implies that farmers cannot easily produce the surplus required to cover fertilizer costs. As a result, farmers do not use as much fertilizer as expected. The amount of fertilizer used on sweet potato is somewhat high given the fact that sweet potato is a food crop and is not preferred to local maize. The high value is due to the small number of farmers who grow sweet potato. The amount of fertilizer applied on local maize does not change and is almost five times less than that applied to hybrid maize.

During the period 1982-87, the price of fertilizer increased and there were more restrictions on credit to smallholders than ever before. It was during this period that the subsidy on fertilizer was substantially reduced, which in turn raised fertilizer prices. As the prices of fertilizer increase, farmers can only apply it on high-valued crops where they can expect some profitable returns, or at minimum be

able to cover the costs involved. Therefore, more fertilizer is applied on hybrid maize and tobacco which are cash crops than on local maize, a food crop. A look at profitability (Table 5.8) makes this point clear.

Table 5.8 Profitability of Major Crops in Malawi (Kwacha/ha).

	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Local maize ^b	82.19	79.98	88.46	86.87	84.46	82.42
Local maize ^c	92.18	81.08	90.77	83.50	68.11	63.31
Composite Maize	131.65	119.61	132.43	120.29	102.29	97.21
Hybrid maize	192.97	210.94	193.03	173.01	146.56	136.32
G/nuts	76.32	86.34	164.18	236.26	247.25	243.66
Rice	85.64	68.39	81.22	152.64	159.03	151.84
Tobacco	87.87	107.57	185.35	269.39	251.55	243.60
Cotton	14.08	106.03	151.26	192.20	147.44	142.88

Note: Profitability here refers to gross margins.

^b Local maize without fertilizer.

^c Local maize with fertilizer.

Source: Nathan Associates. Table 11.4, 1987.

Results 2: Ordinary Least Squares, Probit, and Tobit Analyses

Using the variables defined in Table 5.9, the equations described in Chapter 4 (equations 4.1 to 4.4) were estimated by three methods: ordinary least squares, probit and tobit analyses. This section is devoted to a description of those results. In the ordinary least squares method and tobit analysis, area is positive and significant (Table 5.10). The positive relationship indicates that the larger the area, the more fertilizer a farmer uses. A farmer with a larger landholding is capable of growing a variety of crops including cash crops which he or she sells. Because his/her income is higher than that

Table 5.9 Definition of Variables.

CFERT =	total quantity of fertilizer in kilograms.
AREA =	size of land in hectares.
CLUB =	dummy variable representing membership in a credit club; CLUB=1 if farmer is member; 0 otherwise.
NOCASH =	1 if farmer said he or she didn't apply fertilizer because of "insufficient funds", "lack of credit" or "fertilizer is too expensive".
CMANURE =	dummy variable representing whether smallholder applies manure or not. Cmanure=1 if farmer applies manure; 0 if he or she doesn't.
D1 =	dummy variable representing local maize production by farmer. D1=1 if crop is local maize; 0 otherwise.
D2 =	dummy variable representing hybrid maize production by farmer. D2=1 if crop is hybrid maize; 0 otherwise.
D3 =	dummy representing composite maize production by farmer. D3=1 if crop is composite; 0 otherwise.
D4 =	dummy variable representing rice. D4=1 if crop is rice; 0 otherwise.
D5 =	dummy representing groundnuts. D5=1 if crop is groundnuts; 0 otherwise.
D7 =	dummy variable representing tobacco. D7=1 if crop is tobacco; 0 otherwise.
<u>GENDER =</u>	<u>dummy variable representing gender; gender=1 if male; 0 if female.</u>

of the counterpart who has less land, he/she is able to purchase fertilizer with cash. Even if he/she does not purchase fertilizer with cash, the fact that club membership favors those farmers with large landholdings means that such farmers will obtain fertilizer on credit. As a result, the larger the area a farmer holds, the more fertilizer he/she will apply. On the other hand, membership is almost blocked for those smallholders with small landholdings, and as a result, their chances to obtain fertilizer on credit is almost zero. Inevitably, such farmers will apply little or no fertilizer. A smallholder with a small piece of land mainly grows food crops for household consumption, and will not realize any significant surplus for sale.

In all analyses, a negative and significant relationship exists between nocash and amount of fertilizer a farmer applies. A farmer who

Table 5.10 OLSQ, Probit, and Tobit Estimates for Equation 4.1.

	OLSQ	Probit	Tobit
Dependent Variable	CFERT	CFERT (0,1)	CFERT
Independent Variable:			
Constant	30.8013 (2.90857) ^a	0.573483 (2.42702)	-20.5728 (-1.01674)
Area	32.4790 (7.37990)	0.150132 (1.39233)	48.7622 (6.066358)
Nocash	-66.6673 (-8.33866)	-2.64774 (-14.0997)	-252.560 (-11.9079)
Club	63.0804 (6.74671)	1.07548 (4.79015)	93.4610 (5.90477)
Gender	1.92008 (0.249735)	0.0056853	4.40883 (0.251370)
Cmanure	14.8774 (2.09753)	0.0026406	15.6575 (1.04700)
Log Likelihood	-2967.88	-120.773	-1433.96
R-Squared	0.440821	0.730691	0.86427
Adj R-Squared	0.435328	0.724684	0.85863

^a Figures in parentheses are t-values.

is able to purchase fertilizer with cash or obtain it on credit, will apply more fertilizer than one who has neither cash nor credit.

Probit analysis in column (2) indicates that the inability of a farmer to buy fertilizer with cash or obtain it on credit has a negative effect on the probability to use fertilizer. Tobit analysis in column (3) also gives a negative and significant impact of lack of cash and /or credit on amount of fertilizer used.

Gladwin (1991) showed similar results with the ordinary least squares method. In the wake of fertilizer subsidy withdrawal, the price

of fertilizer has tremendously increased. This means that farmers who have no money and/or cannot now obtain fertilizer on credit will not be able to use fertilizer.

Credit club membership gives positive and significant results in all analyses. In column (2), results indicate membership has a positive and significant effect on the probability that a smallholder will use fertilizer. Tobit analysis in column (3) gives similar results, that is, membership has a positive and significant effect on the amount of fertilizer a smallholder uses. Credit clubs are sources of credit for fertilizer in Malawi. Although membership is not an automatic qualification for credit, the fact that most formal financial institutions and the government give credit to smallholders through these credit clubs, members have a better chance to obtain credit than nonclub members. Farmers who are credit club members will apply more fertilizer than those who are not.

Gladwin (1991) indicates even if some smallholders with small landholdings may have membership, they may not take credit for fear of losing their property if they default on credit. Farmers are likely to fail to purchase fertilizer on cash and therefore, credit becomes the only sure way to obtain fertilizer. This means membership in a credit club is a determining factor of the amount of fertilizer a farmer will use. Therefore, it follows that those farmers who are members apply more fertilizer than nonclub members.

Gender, although positively related to the amount of fertilizer, does not indicate any significant direct effect. However, given the fact that men have always dominated women in credit clubs and, have

larger landholdings and more cash, gender indirectly affects the level of fertilizer use. Married women have automatic membership to credit clubs if their husbands are members. Men have always applied fertilizer obtained from credit clubs on their cash crops and little on no fertilizer is left for those food crops grown by women (Gladwin 1991).

Ability to use manure is significant only in the analysis of the ordinary least squares method. Given the bias of the results of the ordinary least squares method, it is difficult at the moment to make a conclusion based on these results only. Therefore, manure use so far has a questionable impact on the amount of chemical fertilizer a smallholder uses.

In equation 4.2, local maize is included as an independent variable because of its importance as a staple food in Malawi. In the results of Table 5.11, area, nocash and membership to credit club give similar results as in equation 4.1. Local maize has no significant effect on the amount of fertilizer a farmer uses. Local maize is a food crop and most of it is consumed in the household.

When cash and/or credit are limiting factors in fertilizer use, a rational smallholder will not apply fertilizer to local maize since he/she will not be able to repay the credit if the fertilizer was obtained on credit. Also, even if he/she uses cash to purchase fertilizer, he or she will not be able to buy fertilizer for use during the following crop season if fertilizer is applied to local maize, because local maize is not usually sold but is kept for family consumption only. Such a farmer will instead apply fertilizer on cash crops that are more easily sold to obtain money to repay the credit or

Table 5.11 OLSQ, Probit, and Tobit Estimates for Equation 4.2.

Dependent Variable	OLSQ	Probit	Tobit
	CFERT	CFERT (0,1)	CFERT
Independent Variable:			
Constant	36.3175 (2.25434) ^a	0.776618 (1.89181)	-14.2760 (0.444125)
Area	32.5010 (7.37871)	0.150840 (1.40768)	48.7351 (6.06366)
Nocash	-66.5228 (-8.30756)	-2.64506 (-14.0881)	-252.305 (-11.8902)
Club	63.22756 (6.75520)	1.08517 (4.81062)	93.6306 (5.91035)
Gender	2.03337 (0.264125)	0.005322 (0.025547)	4.76410 (0.270803)
Cmanure	15.1174 (2.12384)	0.008255 (0.043568)	15.8504 (1.05874)
D1	-6.28262 (-0.454636)	-0.226520 (-0.608099)	-7.22040 (-0.251768)
Log Likelihood	-2967.78	-120.588	-1433.93
R-square	0.441049	0.731377	0.873261
Adj R-Square	0.434447	0.729385	0.864864

^a Figures in parentheses are values of t-statistics.

to buy fertilizer for next cropping season. It follows then that in a farmer's decision to apply fertilizer, local maize is not a determining factor.

In a situation where the majority of smallholders grow local maize, it is expected that little or no fertilizer will be applied to local maize. This, in fact, is the situation in Malawi.

In equation 4.3, hybrid maize is included instead of local maize. Area, nocash and membership to credit clubs give results similar to those in equations 4.1 and 4.2 (Table 5.12). In a circumstance where cash and/or credit are limiting factors in fertilizer use, farmers tend

Table 5.12 OLSQ, Probit, and Tobit Estimates for Equation 4.3.

	OLSQ	Probit	Tobit
Dependent Variable	CFERT	CFERT (0,1)	CFERT
Independent Variable:			
Constant	23.0213 (2.40438) ^a	0.561353 (2.32751)	-25.4780 (-1.41580)
Area	27.2687 (6.82255)	0.1155170 (1.02373)	41.1815 (5.70744)
Nocash	-58.7680 (-8.11164)	-2.69024 (-13.6509)	-226.197 (-11.9178)
Club	64.0876 (7.60195)	1.11417 (4.83167)	94.6615 (6.71998)
Gender	-0.753114 (-0.108574)	-0.40083 (-0.99971)	-5.34947 (-0.342438)
Cmanure	20.5847 (3.20808)	0.043299 (0.229820)	30.3533 (2.26100)
D2	151.990 (10.8697)	1.61497 (2.90961)	182.008 (8.13243)
Log Likelihood	-2914.04	-115.292	-1404.64
R-Squared	0.54334	0.738621	0.894787
Adj R-Squared	0.540976	0.728864	0.881432

^a Figures in parentheses are t-values.

to overcome such constraints by applying fertilizer on cash crops rather than on food crops. This is why the impact of hybrid maize on amount of fertilizer applied is highly significant. For example, in column (2), hybrid maize has a positive impact on the probability to use fertilizer. Likewise, in column (3) the positive relationship between hybrid maize and the amount of fertilizer applied indicates that more fertilizer is applied if hybrid maize is grown. In a condition of the fertilizer subsidy removal program where fertilizer prices are increased, farmers tend to apply fertilizer on the most profitable crop. Hybrid maize has

a high response to fertilizer and therefore, use of fertilizer on hybrid maize is economically profitable.

Although the price of local maize and hybrid maize is the same in Malawi, a farmer realizes greater gross margins per unit area from hybrid maize than local maize. Consequently he/she will prefer to use fertilizer on hybrid maize over local maize. The question then arises: why do some farmers apply fertilizer on local maize at all? Since local maize is preferred to hybrid maize for consumption, farmers try to ensure its production even at a cost.

Manure use is positive and significant again with the ordinary least squares method and tobit analysis. As a compliment, manure is used in addition to fertilizer to improve soil fertility. This can be explained in two ways. First, smallholders think that organic and chemical fertilizers serve different functions; organic fertilizer helps build good soil structure, while chemical fertilizer delivers needed nitrogen and phosphorus to plants for growth. Thus, they compliment fertilizer with manure. Secondly, those farmers who can afford fertilizer also can afford the costs involved in manure use. In Malawi, an oxcart is required to transport manure to the fields. If a farmer has financial constraints, he/she cannot afford an ox or an oxcart. Those who apply fertilizer, assuming that they have overcome a cash constraint to purchase, can meet the costs involved in manure use. The definition of manure is reported to vary, with many farmers regarding it as any household refuse (Gladwin, personal communication). For our purposes, manure is defined as a collection of plant and/or animal refuse purposely kept for use on farms. Manure application is a sign of

wealth; smallholders who have animals are the ones who use manure and at the same time they use fertilizer.

Results in Table 5.13 confirm the observation that farmers apply fertilizer on cash crops and not on food crops for similar reasons as given above. Hybrid maize and tobacco show a positive and significant effect on the amount of fertilizer a farmer uses. In contrast, the effects of food crops such as local maize, composite maize, and rice are barely significant. Although groundnuts is a cash crop, because it is a woman's crop, it does not receive any observable amount of fertilizer. However, the sign on gender unexpectedly turns negative but still insignificant.

In Table 5.14, tobit results of equations 4.1, 4.2, 4.3, and 4.4 are combined. Results in column (4) indicate that equation 4.4 predicts best the response of a typical smallholder to factors which affect fertilizer use in Malawi. There is no observed correlation between any of the explanatory variables. Manure use is significant when hybrid maize and/or tobacco are cultivated for reasons similar to those given above.

A Simulation Model

To estimate the amount of fertilizer that a smallholder will apply given the above factors, a simulation on area is done (Table 5.15). The mean value for area is calculated and used for simulation in addition to the variables club, nocash, gender, and cmanure. The question then asked is: how much fertilizer will a smallholder use if his/her total land is decreased or increased by a given percentage.

Table 5.13 OLSQ, Probit, and Tobit Estimates for Equation 4.4.

	OLSQ	Probit	Tobit
Dependent Variable	CFERT	CFERT (0,1)	CFERT
Independent Variable:			
Constant	33.8845 (2.24048) ^a	0.503200 (1.10803)	-2.78535 (0.090651)
Area	24.0156 (5.72262)	0.024289 (2.494890)	37.0665 (4.86958)
Nocash	-54.5594 (-7.52583)	-2.69099 (-13.3077)	-219.531 (-11.6760)
Club	56.2560 (6.496650)	1.08934 (4.52466)	85.8830 (5.936666)
Gender	-1.10575 (-0.159351)	-0.043482 (-0.211256)	-6.87823 (-0.440354)
Cmanure	19.4016 (2.91582)	0.081291 (2.400874)	30.7329 (2.23937)
D1	-6.79391 (-0.508215)	-0.100528 (-2.235183)	-14.8786 (-0.529321)
D2	153.014 (11.0243)	1.65513 (3.02978)	183.500 (8.27455)
D3	14.8845 (0.641276)	5.48532 (0.110287)	11.2375 (0.297758)
D4	-6.06980 (-0.677503)	0.100012 (0.364783)	-14.7224 (-0.708956)
D5	-3.96136 (-0.495349)	0.306503 (1.24633)	4.38976 (0.258808)
D7	43.9254 (4.25605)	0.6133772 (3.020240)	43.1417 (2.53062)
Log Likelihood	-2904.51	-112.485	-1401.28
R-Squared	0.562816	0.742997	0.89218
Adj R-Squared	0.553256	0.738448	0.88328

^a Figures in parentheses are t-values.

Table 5.14 Tobit Estimations for Equations 4.1, 4.2, 4.3, and 4.4.

Dependent Variable	CFERT			
Independent Variable:				
Constant	-20.5728 -(1.01674) ²	-14.2760 (0.444125)	-25.4780 -(1.41580)	-2.78535 (0.090651)
Area	48.7622 (6.066358)	48.7351 (6.06366)	41.1815 (5.70744)	37.0665 (4.86958)
Nocash	-252.560 -(11.9079)	-252.305 -(11.8902)	-226.197 -(11.9178)	-219.531 -(11.6760)
Club	93.4610 (5.90477)	93.6306 (5.91036)	94.6615 (6.71998)	85.8830 (5.93666)
Gender	4.40883 (0.251370)	4.76410 (0.270803)	-5.34947 -(0.342438)	-6.87823 -(0.440354)
Cmanure	15.6575 (1.04700)	15.8504 (1.05874)	30.3533 (2.26100)	30.7329 (2.23937)
D1		-7.22040 -(0.251768)		-14.8786 -(0.529321)
D2			182.008 (8.13243)	183.500 (8.27455)
D3				11.2375 (0.297758)
D4				-14.7224 -(0.708976)
D5				4.38976 (0.258808)
D7				43.1417 (2.53062)
Log Likelihood	-1433.96	-1433.93	-1404.64	-1401.28
R-Squared	0.86427	0.873261	0.894787	0.89218
Adj. R-Squared	0.85863	0.864864	0.881432	0.88328

² Figures in parentheses are t-values

For convenience, area is increased and decreased by 15% and 30%. Two typical smallholders A and B are chosen using some prior information on Malawian farmers. Smallholder A is one who is not a credit club member, has a cash constraint, and does not apply manure. Smallholder B is a credit club member, uses manure, and does not have a cash constraint. The simulation model provides different results. In the first case, the predicted values of the amount of fertilizer applied are all zero, regardless of an increase or a decrease in land size. In the second case, the predicted amount of fertilizer applied increases with land size and decreases with a decrease in land size.

Smallholder A does not apply any fertilizer because of the cash and credit constraints. Cash and credit are the major factors that determine whether or not a smallholder will use fertilizer. The smallholder B, because of cash and credit availability, is able to apply fertilizer. The amount of fertilizer increases with area because the larger the land size, the more diversified a smallholder becomes and therefore, the larger is the income. To see the effect of change in area on amount of fertilizer used for a given crop, local maize and hybrid maize are included in the simulation models for equations 4.2 and 4.3 respectively.

For equation 4.2, smallholder A still faces cash and credit constraints, grows local maize and does not use manure. The predicted amount of fertilizer such smallholder A applies turns out to be zero, for similar reasons as previously given.

In equation 4.3, smallholder B is a credit club member, has cash and therefore, does not face cash and credit constraints. This typical smallholder also grows hybrid maize and applies manure.

Table 5.15 Predicted Amount of Fertilizer With Change In Land Size.

Mean Area = 1.15417 ha.
Mean Fertilizer = 49.99972 kg.

Predicted Amount of fertilizer (kg)

% Change in Land size	Equation 4.1		Equation 4.3		Equation 4.4	
	A	B	A	B	A	B
-15	0	132.4	0	309.5	0	363.5
-30	0	140.8	0	316.6	0	370.0
0	0	149.2	0	323.7	0	376.3
15	0	157.7	0	330.9	0	382.8
30	0	166.1	0	338.0	0	389.2

Results from this simulation model indicate an increase in the amount of fertilizer used as the land size increases. These results confirm the argument that to apply fertilizer one must overcome cash and credit constraints, and that fertilizer is applied to cash crops and not food crops. In Malawi, Local maize is mainly grown by women, the reason why in equation 4.2 the smallholder A is possibly a woman. Hybrid maize, because it is a cash crop, is mainly grown by men; smallholder B is possibly a man.

The predicted amount of fertilizer applied by a farmer who grows cash crops such as hybrid maize for a given land size, is derived

through a simulation on area in equation 4.4. Smallholder A, given his or her characteristics defined above, will not use fertilizer.

Smallholder B for similar reasons as above, will use fertilizer. These results indicate an increase in fertilizer use with an increase in land size and vice versa as long as a smallholder overcomes the cash and credit constraints and is a credit club member.

To summarize results of the simulation model in the actual agricultural life of a Malawian farmer, it is important to describe any gender impact on fertilizer use. Although gender has no significant effect on fertilizer use, the gender influence has been shown to be indirect (Gladwin 1991). Women in Malawi have been unfortunate as regards access to credit clubs. It is indicated that female farmers do not apply fertilizer due to lack of credit or cash. This is because their main crop is local maize which does not cover the costs involved if it is grown with fertilizer. On the other hand, groundnuts, another woman's crop is losing land to hybrid maize, which is a male crop. With such low returns, women cannot afford fertilizer on credit and will not apply it on local maize because local maize is consumed within the household. Gladwin (1991) used the ordinary least squares method to determine the factors affecting the amount of fertilizer used per hectare by smallholders using the same variables. Gender and manure use were not significant, although positive. Gladwin's analysis showed, however, that the amount of fertilizer per hectare used turned out to be negatively related to the size of land a farmer held. This would then imply that the smaller the area, the more fertilizer a farmer uses per hectare. Where land is a limiting factor and it cannot be expanded, it

is expected that this would happen. Gladwin provides an insight in the analysis of factors that determine the amount of fertilizer a Malawian smallholder uses. Similar results are obtained if amount of fertilizer per hectare is replaced by total amount of fertilizer as the dependent variable. Area is negatively related to the amount of fertilizer per hectare, while credit club membership and ability to buy fertilizer are significant.

A Comparison of the Three Methods Of Analyses

The variable CFERT has a lower limiting value of zero for a substantial number of observations. This is because many households reported zero amount of fertilizer use. However, other observations range above this lower limit. Such a set of data is said to be truncated. Account should be taken of the concentration of observations at the limiting value of zero when estimating statistically the relationship between the dependent and independent variables (Maddala 1983). The independent variable in such a relationship may be expected to influence both the probability of the limit responses and the size of non-limit responses. If only the probability of limit and non-limit responses were to be explained without regard for the values greater than zero, probit analysis would provide a suitable statistical model. Probit analysis is, however, inefficient because some information on the dependent variable is thrown away although it is available. If there were no concentration of variables at zero value, the method of the ordinary least squares would be appropriate to use. However, with such a concentration, some assumptions of the regression model would not be realized. For instance, only positive deviations are observed when the

limiting value is zero, yet it should be possible under the ordinary least squares method to have negative as well as positive deviations.

Households differ from one another in their behavior regarding the level of fertilizer use for reasons for which the differences in the independent variables and the lower limit do not fully account. By using a tobit model, those other differences are taken to be random with a mean of zero and standardized normal distribution. The tobit model is a hybrid of the probit analysis and the ordinary least squares method; it provides a better statistical estimate of the relationship between the dependent and independent variables (Amemiya 1973, Heckman, 1976, Maddala 1983). The Tobit model therefore, provides the best estimations in a data set with truncated observations. A glance at the R^2 -statistic also confirms this.

Results 3: An Improved Supply Response

As the fertilizer subsidy was gradually withdrawn after 1987/88, the prices of fertilizer increased, affecting gross returns (profitability) for a number of crops (Table 5.16). By considering profitability of various crops, it is possible to tell why smallholders do not apply as much fertilizer on local maize as they do on hybrid maize. The profitability of local maize was constant for seven years from 1980/81 to 1985/86, but increased from 1986/87 to 1989/90. Compared to the profitability of local maize, the profitability of hybrid maize is almost twice as much (Tables 5.16 and 5.18). Farmers, therefore, will grow a crop whose profitability is high. Although the price of both local maize and hybrid maize is the same, yields of hybrid maize with fertilizer application are higher than those of local maize.

In such a situation, farmers who purchase inputs will plant hybrid maize to be able to cover their costs especially of fertilizer. Changes in total hectarage of local maize, hybrid maize, and groundnuts can also be observed in Table 5.16. The total hectarage of local maize is almost constant with little fluctuations, indicating a lack of response to increases in maize prices.

Table 5.16 Profitability of Common Crops in Malawi.

	1980 /81	1981 /82	1982 /83	1983 /84	1984 /85	1985 /86	1986 /87	1987 /88	1988 /89	1989 /90
Price ^b of Maize	6.6	11.1	11.1	12.2	12.2	12.2	12.2	16.7	24.0	-
Profit ^c Local Maize	82	80	88	88	87	84	82	128	187	201
Profit Hybrid Maize	-	193	211	193	173	147	136	253	414	414
Area ^d Local Maize	--	--	--	1068	1048	1104	1132	1138	1163	1180
Area Hybrid Maize	--	--	--	89	75	69	37	59	86	135
Price of G/nuts	33.0	37.0	55.0	60.0	70.0	75.0	75.0	75.0	82.0	--
Area G/nuts	--	--	146	145	136	176	210	176	140	48
Profit G/nuts		76	86	164	236	247	244	238	269	287

Note: Profitability refers to Gross margins, Kwacha/ha.

^b Price tambala/kilogram, 100 Kwacha = 1 tambala.

^c Profitability.

^d Area in thousands of hectares.

Source: Atukorala et al. 1990: Tables 3, 6, 7, and 9.

On the other hand, the total hectarage of hybrid maize shows significant fluctuations. It reaches its minimum of 37 thousand hectares in 1986/87 and then to a maximum of 135 thousand hectares in 1989/90. This indicates a response of hybrid maize to increases in maize prices. Groundnuts trends indicate a decrease in total hectarage from a maximum of 176 thousand hectares in 1985/86 to a disappointing total of only 48 thousand hectares in 1989/90 despite its high profitability. Land from groundnuts is converted to hybrid maize, explaining why total hectarage for hybrid maize increases as that for groundnuts decreases. The significance of this observation is that under SAP, women, who are the main growers of groundnuts, stand to lose. In other words, smallholder farmers will respond to an increase in maize prices by planting hybrid maize rather than groundnuts or local maize. Marginal returns from local maize cannot cover fertilizer costs, especially in the wake of increased fertilizer prices. On the other hand, marginal returns from hybrid maize covers these costs.

It is not possible to estimate with precision the supply elasticities for local maize and hybrid maize due to lack of enough data for time series analysis. Also, the effect of groundnuts cannot be ignored because it is a major crop for smallholders. However, a rough estimate of these supply elasticities can be worked out if percentage changes in hectarage of groundnuts are isolated from those of local maize and hybrid maize. This is done by taking the mean of the hectarage changes of groundnuts during the period when maize price is constant, i.e., from 1984/5 to 1986/87, and using this mean to isolate the hectarage changes of hybrid maize and local maize. Supply

elasticities of local maize and hybrid maize are then calculated and compared (Table 5.17).

Table 5.17 Approximate Elasticities of Local and Hybrid Maize Varieties, 1987/88 and 1988/89 in Malawi.

Crop Year	% Change in Hectarage of Hybrid Maize	% Change in Hectarage of Local Maize	% Change in Price of Maize	% Change in Hectarage of G/Nuts	Approx. Supply Elasticity	
					Hybrid	Local
1984/85	-0.16	-0.02	0	-0.06 ^a		
1985/86	-0.08	0.05	0	0.29 ^a		
1986/87	-0.41	0.03	0	0.19 ^a		
1987/88	0.60	0.01	0.37	-0.16	1.68 ^b	-0.09 ^c
1988/89	0.46	0.02	0.44	0.21	1.00 ^b	0.0 ^{sc}

^a These 3 figures have a mean of 0.14 i.e., change in area of local maize/or hybrid maize with respect to change in area of groundnuts (an approximation of cross elasticity of supply of maize and groundnuts).

Note that price of maize does not change during this period.

^b and ^c are approximate supply elasticities of hybrid and local maize varieties, respectively. Refer to Ch.4 for methodology.

Source: Calculated from Table 5.15 above.

Results indicate that the supply elasticity of hybrid maize for both years is equal or greater than one. The supply elasticity of local maize is almost zero and negative in 1987/88. It was during this period that the fertilizer subsidy was reduced and eventually eliminated. Any increase in the price of maize leads to an increase in the hectarage and therefore, a positive supply response of hybrid maize and not of local maize. The concept of supply elasticity is rather irrelevant in the case of Malawi where prices of crops are fixed by the government. Nonetheless, a failure to increase the production and productivity of local maize, the staple food of Malawi, poses a dangerous situation for both household and national food security.

The percentage change in profitability of local maize and hybrid maize since 1981 can also help us understand the effect of increased fertilizer prices on crop production (Table 5.18).

Table 5.18 Profitability and Percent Change in Profitability of Selected Crops in Malawi.

Year	Profitability of Local Maize	Percent change	Profitability of Hybrid Maize	Percent change
1981/82	82	-	193	-
1982/83	80	-2.0	211	9.3
1983/84	88	10.0	193	-9.3
1984/85	87	-1.1	173	-10.4
1985/86	84	-3.5	147	-15.0
1986/87	82	-2.4	136	-7.5
1987/88	128	56.0	253	86.0
1988/89	187	46.1	414	63.6

Source: Calculated from Atukorala et al. 1990: Tables 3, 6,7, and 9.

Although the percent change in profitability becomes negative in some years, the profitability of hybrid maize is about twice that of local maize. During the years 1987/1988 and 1988/1989, the percent change in profitability is positive for both local and hybrid maize. Still, that for hybrid maize is larger. These results suggest that farmers should respond more to hybrid maize than to local maize. Although the decrease in profitability would reflect increases in prices of all factors of production, 60% of this decrease was accounted for by increases in fertilizer prices (Nathan Associates 1987). In the wake of increased fertilizer prices, farmers should act rationally and apply fertilizer on a more profitable crop, i.e., hybrid maize. A farmer will

not apply fertilizer on local maize, which is not sold, because the increase in maize price does not cover the increased input costs, especially that of fertilizer.

Gendered Impacts

In summary the gendered impacts of Malawi's fertilizer subsidy removal program and structural adjustment arrangements on local consumption and food security are as follows:

- a) Hectarage of hybrid maize, a cash crop grown by men has expanded since 1987/88 at the expense of groundnuts, the woman's cash crop. Land was converted to hybrid maize production from groundnuts production (Table 5.16)
- b) Women's incomes have decreased because total land planted to groundnuts, their cash crop, has since 1987/88 been taken over by men and planted to hybrid maize.
- c) Because their incomes have decreased, women cannot afford to buy fertilizer to apply it to local maize. In turn, little fertilizer has been applied to local maize, a food crop not usually sold but kept for home consumption.
- d) The almost constant hectarage of local maize from 1985/86 to 1989/90 indicates a lack of any increase in the production of local maize (Table 5.16).
- e) Because men require more labor and land as a result of increased production of hybrid maize, they turn to women for additional labor and land requirements. This consequently leads to a relative increase in men's on-farm incomes and a decrease in women's.

f) In the case of unforeseen calamities such as drought, floods, and/or sweeping global economic changes, Malawi's food security is severely threatened in the described situation. In fact, the cropping season of 1990/91 was plagued by such a drought, maize production suffered, and maize had to be imported.

g) Due to all these factors (a) to (f), women farmers stand to lose from the fertilizer subsidy removal program and Malawi's structural adjustment. They are "the losers" rather than "the winners" that Elson (1989) claims to be the result of any macro policy change as big and as widespread as structural adjustment programs in Africa. Women farmers are the unintended "losers" of this program, yet at the same time they are the guardians of the household food supply. In Chapter 6, to resolve this contradiction, some needed changes in Malawi's structural adjustment program are recommended. These are made, not to be critical of the dedicated civil servants of Malawi, but to help make its structural adjustment program more effective way to truly elicit an improved supply response.

CHAPTER 6 DISCUSSION AND CONCLUSION

Summary of Major Findings

Results indicate that the ability of a smallholder to acquire fertilizer is determined by his or her access to cash and/or credit. This is indicated in Tables 5.10 to 5.14. Credit club membership is a determinant factor in fertilizer use because it is through credit clubs that credit is obtained. It is shown that club members apply more fertilizer than nonclub members. Given the fact that access to cash and/or credit is a limiting factor in the quantity of fertilizer used, smallholders who are faced with a fertilizer subsidy removal program and hence an increase in fertilizer prices, will prefer to use fertilizer on hybrid maize which is a tradable, to local maize, a subsistence crop.

The amount of fertilizer applied on hybrid maize is about five times the amount applied on local maize. Because local maize is the staple food of Malawi, there is a need to increase its production. Adoption of hybrid maize has been rather slow, and hybrid maize production is only 5% of total maize production, due to the preference for local maize to hybrid maize by local consumers. Emphasis should be given to increase local maize production by use of intensive agricultural methods particularly through fertilizer use. This cannot be achieved by fertilizer subsidy removal. A fertilizer subsidy means low fertilizer prices which leads to increased cash value for smallholders. The GNP per capita of Malawi has been on a decline since

1980 which means smallholders have less cash than before and therefore their purchasing power is reduced. Less fertilizer will be purchased by smallholders under these circumstances which in turn will lead to smaller crop yields especially of food crops. Therefore, to reverse a decline in crop yields something ought to be done. A fertilizer subsidy is equivalent to a cash subsidy, and as cash held by smallholders goes up, they will use more fertilizer.

Although smallholders would be expected to join credit clubs, more than 45% of farmers in the individual data sample are not members. Gladwin (1991) noted that the policies of credit club admission committees are very restrictive. Farmers with smallholdings often are not admitted because they are poor. Even if they are admitted, many fear obtaining loans since default could mean such farmers would lose all their assets including personal homes.

Results also indicate that an increase in the price and profitability of local maize does not elicit an increased supply response because local maize is not a tradable commodity (Tables 5.16, 5.17, and 5.18). On the other hand, a similar increase in price and profitability elicits an increased supply response of hybrid maize because hybrid maize is a tradable commodity. An increase in maize prices will offset an increase in the price of fertilizer and removal of the fertilizer subsidy in the case of hybrid maize but not of local maize.

With an increase in the price of maize from 1988 to 1991 under structural adjustment arrangements, the area of local maize does not increase, that of groundnuts significantly decreases, while that of

hybrid maize increases during that period (Table 5.16). Given the fact that local maize and groundnuts are crops specifically grown by women, and hybrid maize is grown by men, Malawi's structural adjustment program is not gender neutral; it favors men not only at the expense of women but at the expense of local consumption and food security. This indicates a failure of the structural adjustment program in Malawi to address correctly the issue of price response. The structural adjustment program generates negative effects on women which in turn fail to provide any incentives to smallholders to expand local maize and groundnuts production.

Policy Issues

Research in a number of policy issues needs to be done in order to try to reverse these shortcomings. Smallholders should be encouraged to use more fertilizer, given the fact that fertilizer is still under-utilized in Malawi (Nathan Associates 1987) and there is need to increase their productivity.

Smallholders must be encouraged to join credit clubs and be able to get credit. Market prices for crops produced by smallholders should not be fixed by government. Farmers and consumers have preferred local maize to hybrid maize yet local maize is less fertilizer-responsive than hybrid maize, indicating a need to develop a maize breed that has the good characteristics of local maize but better response to fertilizer. At present, attention is directed only to the removal of the fertilizer subsidy. Additionally, sound policies must be worked out to address all the above issues.

Recommended Policies to Improve Agricultural Development in Malawi

A clear picture has been drawn as regards household and national food security in Malawi. A number of policies can be pursued in order to increase food production and productivity in Malawi. The proposed policy procedures below could be short run or long run. However, a demarcation between short run and long run is difficult given the slow pace at which most African economies move. The following list of 11 strategies, though not exhaustive, would be helpful. Recommendations 1-6 follow directly from the findings of this study, and recommendations 7-11 are indirectly implied by this and other research (Lele 1989, Lele and Christiansen 1989) in order to create an infrastructure conducive to agricultural development. More study is needed to verify the recommendations in the latter category.

1) Develop a flint hybrid

There is a critical need to develop a flint hybrid maize variety which is not only fertilizer responsive, but also has the same good characteristics of local maize (is a flint, has small pounding loss, resistance to moisture, and good storage qualities). If such a variety is developed, higher yields are expected per unit of land than the current ones. This is a long term process and, even if the variety were developed, it will take time for smallholders, who have been eating local maize since time immemorial, to switch to this new variety (Jones and Sakara 1991). The structural adjustment program in Malawi has not been enthusiastic about encouraging the government to invest more money in the development of the flint hybrid.

2) Reinstate the fertilizer subsidy

When the fertilizer subsidy was substantially reduced in 1987/88, fertilizer prices increased. Most smallholder units hold less than one hectare of land, most of which is planted in local maize which is consumed by households. Thus, farmers who already face a cash and/or credit constraint will not afford such high fertilizer prices. Any available fertilizer is then applied to hybrid maize, a cash crop. Because the chances of obtaining additional land are remote, and most of the labor is used in the production of local maize, agricultural productivity would have to be increased through increased fertilizer use. Fertilizer application in Malawi is below the recommended values of Malawi's Ministry of Agriculture. Reinstatement of the fertilizer subsidy will encourage fertilizer use among smallholders because most of them do not have either cash or credit to purchase the fertilizer at current market prices. The fertilizer subsidy rate would be determined by both the inflation rate of the kwacha and increases in transport costs.

3) Encourage crop diversification

Most smallholders' landholdings are under local maize production and, to a lesser extent, hybrid maize production. Because land is a limiting factor in Malawi, other high-valued crops cannot be grown by smallholders. To diversify crop production, some land currently under local maize production needs to be released to the production of other crops. Intensive fertilizer use on local maize by smallholders is a feasible method of achieving this. Withdrawing the fertilizer subsidy will further prohibit crop diversification.

4) Expand credit clubs

Another method to encourage fertilizer use is to give credit to smallholders through credit clubs. While most credit to smallholders is obtained through these credit clubs, accessibility to them is limited. A large percentage of smallholders are not credit club members and, therefore, are not eligible for credit. Credit club membership needs to be encouraged since most farmers have less than one hectare of land, which cannot be accepted as collateral for credit. A system through which smallholders would be able to pay back the credit received needs to be devised. Each smallholder in a credit club would be assured of at least one bag of subsidized fertilizer. Gladwin (1991) has proposed that this bag of fertilizer be applied in the presence of a club member. Given the fact that communal labor is common in Malawi, a number of credit members would be willing to help. A small fee could be charged to this effect and saved in each club's default fund which would be used in cases of individual members' inability to repay fertilizer loans. This would significantly reduce the leakage of fertilizer from the smallholder to the estate sector.

5) Give special credit terms to the smallest of smallholders

Special treatment must be extended to the smallest of the smallholders given their vulnerability to adverse economic policies. A policy such that the smaller the size of land a smallholder possesses, the bigger the fraction of a fertilizer subsidy, would favor this category of smallholders. Such a policy is possible if small fertilizer bags of 25 kg would be packed for farmers with landholdings of one hectare and less. Additional small packages would have the least

stringent credit terms, but farmers would be limited to only two bags apiece. This would help to overcome any influence of smallholders with relatively big landholdings from taking advantage of the fertilizer subsidy at the expense of the smallest smallholders. This arrangement also would help to address the needs of non credit club smallholders as well as female farmers.

6) Intensify local maize production

Results show that the production of local maize does not expand, yet that of hybrid maize and tobacco expands when product prices increase. If more fertilizer were available to smallholders, more of it could be applied to local maize as well, increasing food supplies. A special program needs to be devised to address local maize production. Fertilizer subsidy recipients should be prioritized, beginning with those households who at the moment cannot meet their food requirements. At the same time, a food subsidy to households which are food deficient would be provided. The current policy of subsidizing food prices for all consumers discourages smallholders who receive lower prices for their crops.

A special program for local maize production would lead to increased production and smallholders would be able to sell the surplus. In the long run this would increase the profitability of local maize. Also, because most of the local maize is grown by women who are responsible for food security in households, membership to credit clubs should be open to them directly, as opposed to indirectly through their husbands. Women will then be able to obtain their own fertilizer.

Increased fertilizer use will release some of the labor required for food production and agriculture in general. This would then enable women to undertake other activities such as improved home economics, vegetable growing, and small animal production. For men, this would encourage vigorous off farm activities and, therefore, increased incomes.

Decontrol of producer prices would also be helpful in an effort to intensify local maize production. An imperfect market exists for smallholders' outputs in Malawi. SAP recommendations to remove the fertilizer subsidy aim at decontrol of prices. This, however, is only applied to inputs. The prices of maize, groundnuts, and other smallholder product prices are still fixed by the Government of Malawi. This makes the notion of supply elasticity, explored on pages 92-96, rather irrelevant, and in turn blocks the SAP goal to provide price incentives to farmers so that they can improve their supply response.

There is a need, therefore, to deregulate prices of smallholder products and let them be determined by market forces. Since the demand for local maize is higher than that of hybrid maize, it is expected that the price of local maize would surpass that for hybrid maize on the open market. This would then mean that the profitability of local maize would be higher than that of hybrid maize leading to increased production of local maize.

7) Decrease leakages

Leakages of fertilizer from smallholders to estate farmers has been reported in Malawi (Nathan Associates 1987). More study ought to be done so as to find ways to reduce and eventually stop this habit.

Possibly the extension service needs to provide a more detailed study program particularly addressing this problem. Field assistants and local leadership would be useful.

8) Encourage rural savings and investment

A study to identify the ways and means of encouraging rural savings and investment would be helpful in Malawi where credit has been identified as a major constraint of agricultural development. For instance, a rural savings fund could be established for a given number of credit clubs in a given location. The initial funds would be obtained through savings and/or borrowing. This would provide credit to smallholders, regardless of their collaterality. The only collateral required would be good will. By establishing a savings fund, costs associated with small loans given to smallholders would be eliminated. This would also lower the cost of credit and, therefore, interest rates as well.

9) Organize smallholders through cooperative societies

Farmers throughout the developing world are organizing themselves into cooperative societies as a way to pool resources together. These farmers are then able to obtain cheaper farm inputs, market their produce, and acquire basic household needs. A study of how to involve Malawian smallholders into cooperatives would be helpful. Cooperatives are known to be incentives for grassroots participation.

These cooperatives should not be a policy tool for the government and should not be a substitute for private enterprise in the private sector (Lele and Christiansen 1989). They ought to be owned by the rural people themselves and not operated on their behalf. As a

guideline, for example, membership to a cooperative society should not be limited to smallholders, but should be open to their sons and daughters currently employed in towns. With savings, such a cooperative would become a business entity and could undertake various business transactions as it expands.

10) Eliminate bias between smallholder and estate sectors; cut back the role of ADMARC

The bias between the smallholder and the estate sector could be addressed such that differences in prices for their respective crops be abolished (Lele and Christiansen 1989). More study is needed in the alternatives to the monopoly of ADMARC in smallholder agricultural marketing. Should smallholders be able to sell their maize, for example, to any market and not to ADMARC exclusively? Possibly ADMARC would be the last buyer if a smallholder fails to find a better market. In addition, smallholders might be allowed to grow any kind of tobacco, even the higher-valued kinds such as the fire-cured tobacco and burley.

The role presently of ADMARC to ensure food security in Malawi ought to remain if ADMARC is changed or abolished. However, the role of ADMARC as a monopsonist of all smallholder produce should be reduced (Lele and Christiansen 1989). By allowing other competitive companies to participate in the marketing system, the government would not have to fix producer prices; the market would do it. The same concept is valid as regards farm input supplies: should ADMARC be a monopolist in fertilizer sales? Caution ought to be taken during a reform, if recommended during any study, such that ADMARC is not replaced by another less effective infrastructure.

Private traders in Malawi are not as active as they are assumed to be and cannot meet the challenges of agricultural marketing because these traders have transport and capital constraints which are hurdles to the privatization process (Lele and Christiansen 1989). More information is still needed for example, in the socio-political system, in order to devise appropriate steps to be taken in the reform process.

11) Enhance local action and people's participation

Glemie (1979) and Kafumba (1983) have shown the positive role of people's participation in various rural projects at the grassroots level in Malawi. More research is needed in order to identify democratization and politicization processes at the grassroots level that are development-oriented. During rural development, of which agriculture is part, democratization and people's participation have become cornerstones in the adoption of new technologies (Uphoff 1986).

Transfer of instruments of power to development committees at the village level is another possibility for study and evaluation. These committees might better recognize local needs than the people from the city who come and "guess". The village committees possibly could direct any government assistance offered to them. Also, to increase people's participation and awareness, the government might coordinate its activities with nongovernment organizations currently engaged in rural agricultural development.

Through local action, greater political and economic independence for local people will be achieved, risk will be reduced, and the flow of technical information to innovative farmers will be facilitated. In addition, consolidation of local resources to promote efficiency would

be encouraged. The notion that rural people are incapable of determining their needs because most of them are illiterate is unfair. Indeed, in conclusion, Hellinger et al. (1988: 179) had this to say:

We are at a crossroads. The profound problems that the trillion-dollar Third World debt both reveals and creates will not go away. We have a choice. We can continue to define development for the people of the Third World, wrapping it in the rhetoric of whatever fad or cliché follows "basic human needs" or "private-sector initiative," or we can let go and allow the poor to define their own needs and support them ... We need to change the paradigm.... We can play a role in the engendering of equitable, broad-based, self sustaining development and new democratic structures.

REFERENCES

- Addison, Tony and Lionel Demery. "The Economics of Rural Poverty Alleviation." Structural Adjustment and Agriculture, ed. Simon Commander. London: Overseas Development Institute, 1989.
- Amemiya, T. "Regression Analysis When the Dependent Variable is Truncated Normal." Econometrica, 41 (1973): 997-1016.
- ASA. Annual Survey in Agriculture. Ministry of Agriculture, Malawi. Unpublished, Zomba, Malawi. 1984/85.
- Atukorala, Vimal, Alan Batchelder, George Gardener, and Theresa Ware. The Malawi Fertilizer Subsidy Reduction Program. The Impact of the African Economic Policy Reform Program. AID Project Impact Evaluation Report No. XX, Washington, D.C.: U.S. Government Printing Office, 1990.
- Bates, Robert. Markets and States in Tropical Africa. The Political Basis of Agricultural Policies. Berkeley: University of California Press, 1981.
- _____. "The Reality of Structural Adjustment: A Skeptical Appraisal." Structural Adjustment and Agriculture, ed. Simon Commander. London: Overseas Development Institute, 1989.
- Berg, Elliot. Structural Adjustment and Its Critics. Monograph, Elliot Berg Associates, Washington, D.C., 1989.
- Chhibber, Ajayi. "Articulating Stabilization Programs and Structural Adjustment." Structural Adjustment and Agriculture, ed. Simon Commander. London: Overseas Development Institute, 1989.
- Christiansen, Robert and J.G. Kydd. Malawi's Agricultural Export Strategy and Implications for Income Distribution. International Economics Division, Economic Research Service, USDA. Report No. AGES 8702224, Washington D.C., 1987.
- Christiansen, Robert and V. Roy Southworth. Agricultural Pricing and Marketing Policy in Malawi: Implications for a Development Strategy. Paper Presented at the "Symposium on Agricultural Policies for Growth and Development" sponsored by USAID at Mangochi, Malawi, October 31 to November 4, 1988.

- Cornia, Giovanni, Richard Jolly, and Frances Stewart. Vol. I: "Protecting the Vulnerable and Promoting Growth." Vol. II: "Ten Country Case Studies." Adjustment With a Human Face, eds. Cornia, Giovanni, Richard Jolly, and Frances Stewart. Oxford: Clarendon Press for UNICEF, 1987.
- Due, Jean M. "Policies to Overcome the Negative Effects of Structural Adjustment Programs on African Female-headed Households." Structural Adjustment and African Women Farmers, ed. Christina Gladwin. Gainesville: University of Florida Press, 1991.
- ECA. United Nations Economic Commission for Africa. African Alternative Framework to Structural Adjustment Programs for Socio-Economic Recovery and Transformation. E/ECA/CM.15/6/Rev.3. New York: United Nations, 1989.
- Elson, Diane. "The Impact of Structural Adjustment on Women: Concepts and Issues." Vol. II The IMF, The World Bank, and the African Debt, ed. Bade Onimode. London: Zed Books, 1989.
- _____. "Male Bias in Macro-economics: The Case of Structural Adjustment." Male Bias in the Development Process, ed. Diane Elson. Manchester: Manchester University Press, 1991.
- FAO. Land, Food and People. Rome: United Nations Food and Agricultural Organization, 1984.
- Ghai, Dharam and Samir Radwan. "Growth and Inequality: Rural Development in Malawi, 1964-1978." Agrarian Reform and Rural Poverty in Africa, eds. Dharam Ghai and Samir Radwan. Geneva, 1983.
- Ghatak, Subrata and Ken Ingersent. Agriculture and Economic Development. Baltimore: Johns Hopkins University Press, 1984.
- Gladwin, Christina. Ethnographic Decision Tree Modeling. Sage University Paper Series on Qualitative Research Methods, Vol. 19. Beverly Hills, CA: Sage, 1989a.
- _____. "Indigenous Knowledge Systems, Cognitive Revolution, and Agricultural Decision Making." Agriculture and Human Values, Summer, 1989b: 32-41.
- _____. "Fertilizer Subsidy Removal Programs and Their Potential Impacts on Women Farmers in Malawi and Cameroon." Structural Adjustment and African Women Farmers, ed. Christina Gladwin. Gainesville: University of Florida Press, 1991.
- Glemie, Colin. The Rural Piped Water Program in Malawi. A Case Study of Community Participation. M.S. Thesis. University of London, 1979.

- Greene, Reginald H. "Articulating Stabilization Programs and Structural Adjustment." Structural Adjustment and Agriculture, ed. Simon Commander. London: Overseas Development Institute, 1989.
- Grootaert, Christiaan and Ravi Kanbur. Policy-oriented Analysis of Poverty and the Social Dimensions of Structural Adjustment. A Methodology and Proposed Application to Cote d'Ivoire, 1958-88. Washington, D.C.: The World Bank, 1989.
- Gujarat, Damodar N. Basic Econometrics. New York: McGraw-Hill, 1988.
- Heckman, J. "The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimation for Such Models." Annals of Economic and Social Measurements, Vol. 5 (1976): 445-492.
- Hellinger, Stephen, Douglas Hellinger, and Fred M. O'Regan. Aid For Just Development. Report on The Future of Foreign Assistance. Boulder: Lynne Rienner, 1988.
- Hilderbrand, Peter. "Modified Stability Analysis of Farmer Managed, On-Farm Trials." Agronomy Journal, Vol. 76, (1984): 271-274.
- Hunderink, J. and J.J. Sterkenburg. Agricultural Commercialization and Government Policy in Africa. London: KPI, 1987.
- Johnston, Bruce F., and P. Kilby. Agriculture and Structural Transformation: Economic Strategies in Late-Developing Countries. New York: Oxford University Press, 1975.
- Jones, R.B., and W.D. Sakala. "An Informal Survey of Maize Agronomic Practices in Kasungu and Lilongwe Agricultural Development Divisions, Malawi." CIMMYT, ed. Farming Systems Bulletin Eastern and Southern Africa No.8 January-June 1991.
- Kafumba, Charles. Increasing Farmer Participation in a Smallholder-Oriented Forestry Project: Analysis of the World Energy Project in Malawi. M.S. Thesis. Ithaca, New York: Cornell University, 1983.
- Kinsey, B.H. Agricultural Pricing and Marketing of Smallholder Crops in Malawi: A Policy Review. Overseas Development Group. Norwich, UK: University of East Angalia. Mimeographed, 1978.
- Lele, Uma. "Agricultural Growth Domestic Policies, the External Environment and Assistance to Africa: Lessons of a Quarter Century." Trade, Aid, and Policy Reform, ed. Colleen Roberts. New York: McGraw-Hill, 1988.
- _____. Sources of Growth in East African Agriculture. International Bank for Reconstruction and World Bank. Washington, D.C.: The World Bank, 1989.

- _____. "Women, Structural Adjustment, and Transformation: Some Lessons and Questions from the African Experience." Structural Adjustment and African Women Farmers, ed. Christina Gladwin. Gainesville: University of Florida Press, 1991.
- _____, and Manmohan Agarwal. Smallholder and Large-Scale Agriculture in Africa. Are there Trade-offs Between Growth and Equity? MADIA Discussion Paper No.6. Washington, D.C.: World Bank, 1989.
- _____, and Robert E. Christiansen. Marketing Boards and Cooperatives in Africa. Issues in Adjustment Policy. MADIA Discussion Paper 11. Washington, D.C.: World Bank, 1989.
- _____, Robert E. Christiansen, and Kundavi Kadiresen. Fertilizer Policy in Africa. Lessons from Development and Adjustment Lending 1979-87. MADIA Discussion Paper 5. Washington D.C.: World Bank, 1988.
- _____ and Kofi Adu-Nyako. An Integrated Approach of Strategies for Poverty Alleviation. A Paramount Priority for Africa. African Development Bank Group. 1991 Annual Meeting Symposium 6 May Abidjan, The Ivory Coast, 1991.
- Longhurst, R. "Structural Adjustment and Vulnerable Groups in Sierra Leone. Stabilization for Destabilization, Stagnation and/or Growth?" Short run Costs and Long run Uncertainties in Africa, eds. C.L. Colcough and R.H. Green. IDS Bulletin, Vol. 19, No.3, 1988.
- Maddala, G.S. Limited-dependent and Qualitative Variables in Econometrics. New York: Cambridge University Press, 1983.
- Mehra, Rekha. Can Structural Adjustment Work for Women Farmers? Washington, D.C.: International Center for Research on Women. 1990.
- Meier, Gerald M., and William F. Steel. Industrial Adjustment in Sub-Saharan Africa. New York: Oxford University Press, 1989.
- Mellor, John. International Food Policy Research Institute Report. Washington D.C.: IFPRI, 1984.
- Mikell, Gwendolyn. "Ghanaian Females, Rural Economy and National Stabilization." African Studies Review 29 Vol. 3 (1986): 67-88.
- Mkandawire, Richard M. and Chimimba David Phiri. Malawi Land Policy Study: Assessment of Land Transfer from Smallholders to Estates. Washington, D.C.: World Bank Eastern and Southern Africa Projects Department, 1987.

- Nathan Associates. The Impact of the Fertilizer Subsidy Removal Program on Smallholder Agriculture in Malawi. Zomba, Malawi: Report presented to Ministry of Agriculture and the USAID., 1987.
- National Sample Survey of Agriculture 1980/81, Vol.1. Zomba, Malawi: NSO, 1984.
- O'Brien, Stephen. "Structural Adjustment and Structural Transformation in Sub-Saharan Africa." Structural Adjustment and African Women Farmers, ed. Christina Gladwin. Gainesville: University of Florida Press, 1991.
- Pindyck, Robert and Daniel Rubinfeld. Econometric Models and Economic Forecasts. New York: McGraw-Hill, 1981.
- RFS. Rapid Fertilizer Survey, 1985/86 and 1986/87. Unpublished. Zomba, Malawi: 1987.
- Sahn, David E., Jehan Arupragason, and Lemma Merid. Policy Reform and Poverty in Malawi: A Survey of a Decade of Experience. Washington, D.C.: Cornell University Foods and Nutrients Program, 1990.
- Statement of Development Policies 1987-1996, Republic of Malawi. Zomba: Government Printer, 1987.
- Staudt, Kathleen A. "Women Farmers and Inequalities in Agricultural Services." Women and Work in Africa, ed. Edna Bay. Boulder: Westview Press, 1982.
- Streeten, Paul. "A Survey of the Issues and Options." Structural Adjustment in Agriculture, ed. Simon Commander. London: Overseas Development Institute, 1989.
- Svedberg, Peter. The Export Performance of Sub-Saharan Africa. Helsinki: Institute for International Economic Studies, University of Stockholm, and World Institute for Development Economics Research, United Nations University, 1987.
- Timmer, Peter C., Walter Falcon, and Scott Pearson. Food Policy Analysis. Washington, D.C.: World Bank, 1983.
- Uphoff, Norman. Local Institutional Development: An Analytical Sourcebook with Cases. Ithaca, New York: Rural Development Committee, Cornell University, Kumarian Press, 1986.
- World Bank. Accelerated Development in Sub-Saharan Africa: An Agenda For Action. Washington, D.C.: World Bank, 1981.
- _____. Towards Sustained Development in Sub-Saharan Africa. A Joint Program of Action. Washington, D.C.: World Bank, 1984.

- _____. Report on Adjustment Lending. Washington, D.C.: World Bank, 1986.
- _____. Financing Adjustment With Growth in Sub-Saharan Africa 1986-89. Washington, D.C.: World Bank, 1989a.
- _____. Sub-Saharan Africa: From Crisis to Sustainable Growth. Washington, D.C.: World Bank, 1989b.
- World Bank/the UNDP. Africa's Adjustment and Growth in the 1980s. A Joint World Bank-UNDP Publication. Washington, D.C.: World Bank, 1989.

BIOGRAPHICAL SKETCH

George Lukwago was born on April 4, 1961, at Mpigi in Uganda. He attended Kyengeza, Mityana, and Nyakasura Schools. He obtained a B.Sc. (in Agriculture) from Makerere University, Kampala, in 1986. In 1987 he joined the Ministry of Agriculture, Research Division, and was posted to Kawanda Research Station as a scientific officer (agroeconomics/farming systems research) where he has since interacted with both scientists and farmers. He has pursued a Master of Science (Agricultural economics) degree at the University of Florida (USA) in the Department of Food and Resource Economics since 1990. He is interested in small-scale farming, development economics and policy analysis.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

Christina Gladwin, Chairperson
Professor of Food and Resource
Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

Chris Andrew
Professor of Food and Resource
Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

Peter Hilderbrand
Professor of Food and resource
Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

Ronald Ward
Professor of Food and Resource
Economics

This thesis was submitted to the Graduate Faculty of the College of Agriculture and to the Graduate School and was acceptable as a partial fulfillment of the requirements for the degree of Master of Science.

May 1992

Dean, College of Agriculture

Dean, Graduate School